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"To the solid ground
Of nature trusts the Mind that builds for aye."—WORDSWORTH.

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INDEX

NAME INDEX

Abelson (P.), [S. F. Cook, K. G. Scott and], Deposition of Radio-phosphorus in Tissues of Growing Chicks, 944

Abercrombie (M.), elected a junior research fellow in zoology at Queen's College, Oxford University, 38

Abraham (E. P.), elected to a taberdarship in chemistry at Queen's College, Oxford University, 38; and Prof. R. Robinson, Crystallization of Lysozyme, 24

Abraham (W. E. V.), Geological Aspects of Deep Drilling Problems, 73

Adam (Miss M. G.), appointed assistant tutor in science at St. Hugh's College, Oxford, 38

Adam (Flight-Lieut. M. J.), World's Air Altitude Record, 56

Adam (Prof. N. K.), Pollution of Sea and Shore by Oil, 100; Use of the Word Substrate, 158

Adams (Dr. F. D.), awarded the Flavelle medal of the Royal Society of Canada, 287

Adams (Dr. R.), Inter-racial Marriage in Hawaii (*Review*), 665

Aebersold (P. C.), [G. N. Snell and], Production of Sterility in Male Mice by Irradiation with Neutrons, 779

Agar (Prof. W. E.), Cytology of *Lepidosiren*, 931

Ahier (G.), Christiansen Filters, 477

Ainsworth (Dr. G. C.), The Plant Diseases of Great Britain: a Bibliography (*Review*), 91

Airey (Dr. J. R.), [death], 536; [obituary article], 796

Aitken (A. C.), Studies in Practical Mathematics (2), 124

Aitken, Allott, Castleden and Walker, Potassium and Paralysis, 367

Aldersloff (Prof. H.), [death], 455

Alexander (W.), and J. Swaffield, Magnetostriction, 1068

Algar (J.), and Isabella P. Carey, Synthesis of Flavonols: Oxidation of Flavindogenides, 292

Alington (Very Rev. Dr. C. A.), elected president of the University of Durham Philosophical Society, 967

Allen (Dr. C.), Modern Discoveries in Medical Psychology (*Review*), 343

Allen (Dr. J. F.), Dr. R. Peierls and M. Zaki Uddin, Heat Conduction in Liquid Helium, 62

Allibone (Dr. T. E.), and J. M. Meek, Development of the Spark Discharge, 804

Allmand (Prof. A. J.), appointed Daniell professor of chemistry at King's College, London, 942

Almquist (H. J.), Crystals with Vitamin K Potency, 25

Alty (T.), Sublimation and Condensation of Crystals, 814

Amat (M.), [J. Duclaux and], Ultra-filters of Carborundum, 656

Anderson (Dr. G. C.), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166

Anderson (Dr. J.), appointed representative of the Scottish Beekeepers' Association on the Bee Research Committee, 274

Anderson (Dr. J. S.), Structure of Organic Molecular Compounds, 583; Constitution of the Poly-acids, 850

Anderssen (F. G.), Citrus Manuring, 976

Andrade (Prof. E. N. da C.), The Mechanism of Nature, being a simple approach to Modern Views on the Structure of Matter and Radiation. Revised edition (*Review*), 260; Lord Rutherford, 753; Interpretations of Atomic Constitution, 894; and R. C. Parker, Absolute Measurements of Sound Intensity, 34

Angell (J. R.), and others, A History of Psychology in Autobiography. Vol. 3. Edited by C. Murchison (*Review*), 830

Angström (A.), A Coefficient of Humidity of General Applicability, 160

Angus (Prof. R. W.), elected an honorary member of the Engineering Institute of Canada, 274

Anthony (Dr. H.), 'Shiva's Temple', Arizona, 613

Arakatsu (B.), K. Kimura and Y. Uemura, Expulsion of Neutrons from Lead by Cosmic Rays, 277

Arbour-Stephens (Dr. G.), Clean Milk and Pasteurization, 614

Arensberg (Dr. C. M.), The Irish Countryman: An Anthropological Study (*Review*), 299

Armstrong (A. L.), Rev. N. Jones and H. B. Maufe, Antiquity of Man in Rhodesia, 469

Armstrong (Dr. E. F.), Tendencies of World Power Development, 706; awarded an honorary associateship of the Birmingham Central Technical College, 929

Armstrong (Prof. H. E.), [death], 97; [obituary article], 140; (late Prof. H. E.), Ammonolatry: the Life Element, 134

Armstrong (J. M.), Cytology of the genus *Poa*, 368

Arthur (J. C.), and G. B. Cummins, Rust Fungi of the Philippines, 648

Ashby (Dr. E.), appointed professor of botany in Sydney University; work of, 883; resignation from Bristol University, 904

Asmus (Dr. R.), Organische Synthesen (Organic Syntheses) (*Review*), 486

Astbury (Dr. W. T.), Relation between 'Fibrous' and 'Globular' Proteins, 968; X-Rays and Wool Fibre, 1069

Aste-Salazar (J. H.), [J. W. Thompson, W. Corwin and], Physiological Patterns and Mental Disturbances, 1062

Aston (Dr. F. W.), Packing Fractions of Krypton and Xenon, 149; A Second-order Focusing Mass Spectrograph and Isotopic Weights by the Doublet Method, 905

Atanasiu (M.), Natural Convection in Liquids, 985

Atkinson (Dr. R. d'E.) appointed chief assistant at the Royal Observatory, Greenwich; work of, 457

Attems (Dr. C.), Millipedes of India, 72

Audubert (R.), Ultra-violet Emission Spectrum of the Slow Thermal Dissociation of Silver Nitride, 518

Auerbach (Dr. C.), [Prof. F. A. E. Crew and], 'Spheroidal': A Mutant in *Drosophila funebris* affecting Egg Size and Shape, and Fecundity, 124; New Mutation in *Drosophila*, 898

Aufrère (L.), Boucher de Perthes and the Foundations of Prehistoric Archæology, 261

Auger (P.), P. Ehrenfest, jun., A. Freon and Mme. Thérèse Grivet, Mechanism of the Production of Cosmic Bundles, 292

Auger (V.), and Mlle. Nina Ivanoff, Molybdenum Blues, 293

Augustus, Emperor, Bimillenary of the, 577

Austin (Lord), conferment upon, of an honorary doctorate by Birmingham University, 80

Aveling (Prof. F.), Science in Psychology (*Review*), 909

Ayres (Prof. Q. C.), Soil Erosion and its Control (*Review*), 445

d'Azambuja (L.), International Co-operation for the Continuous Observation of the Sun, and its First Results, 208

Ba Thi (M.), T. G. Hunter and A. W. Nash and others, Solvent Dewaxing, 1105

Baber (T. D. H.), appointed an assistant lecturer in mathematics in Sheffield University, 735

Bacharach (A. L.), Adsorption Columns (*Review*), 48; Harris's Vitamins in Theory and Practice (*Review*), 302; and H. E. Glynn, Liver Extract and Hæmoglobin in Rats, 896; [Dr. B. P. Wiesner and], Effect upon Sex Behaviour of a Diet Deficient in Vitamin E, 972

Bachellery (A.), Electrification of the Paris–Orléans and Midi Railways, 1025

Bacsich (Dr. P.), appointed lecturer in embryology in Glasgow University, 654

Baddar (F. G.), and F. L. Warren, Synthesis of Benzanthrones, 321

Badenhuizen, jun. (N. P.), [Prof. K. H. Meyer and], Transformation of Hydrate Cellulose into Native Cellulose, 281

Baden-Powell (Major B. F. S.), [death], 611

Baehni (C.), Male Inflorescence of *Scyphostegia borneensis*, 737

Baekeland (Prof. L. H.), conferment upon, of an honorary doctorate by Edinburgh University, 80

Baens (L.), and F. M. Yenks, Effect of Moulds upon Tanning Liquors, 687

Baerts (F.), and R. Vandewijer, Alkalinity of the Ash and Loss of Chlorine on Incineration, 943

Bailey (C. R.), Infra-red Absorption of Carbon Disulphide, 851

Bailey (Prof. E. B.), Prof. A. Heim, 573

Bailey (Prof. K. C.), The Retardation of Chemical Reactions (*Review*), 340; Behaviour of Cylinders of Inflammable Gas in a Fire: Extinguishing Flames by Coal Gas, 503; Tritium or Triterium ?, 590; and G. T. Taylor, Retardation of Chemical Reactions, 327

Baily (Prof. F. G.), and others, Universities and Education, 689

Bake (Dr. A. A.), appointed a senior research fellow of Brasenose College, Oxford, 694

Baker (Dr. J. R.), Nomenclature of the Seasons, 890

Balavoine (P.), Variation of the Iodine Value of Drying Oils according to their Origin, 125

Balchin (W. G. V.), Erosion Surfaces of Cornwall, 326

Bald (J. G.), Ecology of Tomato 'Spotted Wilt' Virus, 1019; and G. E. Briggs, Aggregation of Virus Particles, 111

Baldick (K. J.), and F. Lions, Derivatives of 6 : 7-Dimethoxybenzoparathiazine, 695

Baltazard (M.), [G. Blanc and], Cross Immunity between the Pustular Fever and Purpura Fever of the Rocky Mountains, 905

Baly (Prof. E. C. C.), Photosynthesis of Carbohydrates *in vitro*, 930

Bamford (C. H.), elected a fellow of Trinity College, Cambridge, 735; [Prof. R. G. W. Norrish and], Photodecomposition of Aldehydes and Ketones, 195

Bangham (Prof. D. H.), S. Mosallam and Z. Saweris, Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces, 237

Banks (E.), Intoxicants in Sarawak, 936

Banting (Sir Frederick), Early Work on Insulin, 901

Barber (A.), [Dr. F. C. Champion and], Production of Positron and Electron Pairs by bombardment of Mercury with β-Particles of Low Energy, 105

Barclay (A.), Chemistry: A Brief Outline of its History and Development, 232

Barger (Prof. G.), appointed regius professor of chemistry in Glasgow University, 537, 556; work of, 537

Barkworth (Capt. H.), and L. W. L. Cole, Acidosis and Off-Flavoured Milk, 324

Barling (Sir Harry Gilbert), conferment upon, of an honorary doctorate by Birmingham University, 80

Barnes (Dr. C.), Masses and Parallaxes of Binary Stars, 286

Baron (J.), and P. Laffitte, Inflammation of Acetaldehyde, 477

Barrer (R. M.), Nature of the Diffusion Process in Rubber, 106

Barrett (Sir James), Central (Native) Medical School, Suva, Fiji, 472

Barrett (Sir William), Personality Survives Death: Messages from. Edited by his wife (*Review*), 1078

Barrie (H. J.), appointed demonstrator in pathology in Sheffield University, 904

Barrie (Miss M. M. O.), Vitamin E Deficiency in the Suckling Rat, 426

Barry (A. M.), appointed a Frank Edward Elmore student in Cambridge University, 123; awarded the E. G. Fearnsides scholarship of Cambridge University, 291

Barry (D. R.), Changes of Colour by Injection of Pituitary Extracts in a Dogfish (*Scylliorhinus canicula*), 769

Bartlett (Prof. F. C.), Native Science in Southern Sudan (*Review*), 338

Bartley (Mary A.), [W. J. Robbins, A. G. Hogan, L. R. Richardson and], Pyrimidine and Thiazole Intermediates as substitutes for Vitamin B, 779; [W. J. Robbins and], Thiazole and the Growth of Excised Tomato Roots, 779

Barton (H. J.), [H. W. Newton and], Bright Solar Eruptions and Radio Fadings in 1935–36, 688

von Basch (Samuel Siegfried Karl) (1837–1905); work of, 393

Bassière (M.), Structure of Cadmium Nitride (Hydrazoate), 125

Bate (Dorothea M. A.), [Elinor W. Gardner and], The Bone-bearing Beds of Bethlehem: Their Fauna and Industry, 431

Bateman (Dr. J. B.), International Congress for Short Waves in Physics, Biology and Medicine, Vienna, 372; Mitogenetic Radiation and the Theory of Nerve Excitation (*Review*), 565; Dr. H. Loewenthal and Dr. H. Rosenberg, Alleged Specific Effects of High Frequency Fields on Biological Substances, 1063

Bates (R. G.), and W. C. Vosburgh, Potential of the Iodine Electrode, 776

Batten (Miss Jean), awarded the gold medal of the Royal Aero Club, 844

Bauer (D. J.), elected Michael Foster student in physiology in Cambridge University, 291

Bauer (P. T.), awarded the Wrenbury scholarship of Cambridge University, 291

Bauer (S. H.), Structure of Diborane, 552

Bawden (F. C.), and N. W. Pirie, Crystalline Preparations of Viruses, 1018

Baxt (L. M.), renewal to, of a Salters' Institute fellowship, 274

Baxter (A. M.), awarded the Sir William White postgraduate scholarship of the Institution of Naval Architects, 422

Bayley (D. S.), and H. R. Crane, The β-rays from Lithium and Boron Isotopes, 776

Beadle (G. W.), and B. Ephrussi, Ovary Transplants in *Drosophila melanogaster*; Meiosis and Crossing-over in Super Females, 779

Beadle (L. C.), and F. A. Booth, An Inexpensive Low-Temperature Thermostat, 279

Beadnell (Surgeon Rear-Admiral C. M.), An Inquiry into "Marvels" (*Review*), 87

Beal (J. M.), Bud Development in *Lilium Harrisii* following Treatment with Indoleacetic Acid, 519

Beams (Prof. J. W.), [Dr. F. T. Holmes and], Frictional Torque of an Axial Magnetic Suspension, 30

Beatty (A. Chester), gift to London University for a scholarship in radiology, 778; gift to the Royal Cancer Hospital, 844

Beaumont (A.), [death], 309; and P. H. Gregory, A Leaf-spot Disease of *Gerbera Jamesoni*, 511

Bedson (Prof. S. P.), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166

Běhounek (Dr. F.), and F. V. Novák, Retention of Radioactive Substances in the body of Rats and the Letha Dose, 106

Behrens (Hon. Mrs.), endowment of a Clive Behren lectureship in Leeds University, 166

Beischer (D.), and A. Winkel, Size of Particles Responsib for Ferromagnetism, 202

Belcher (D.), Effect of Viscosity on Ionic Mobilities, 8

de Belin (G. A.), appointed assistant lecturer and research assistant in the department of metallurgy of Sheffield University, 207
Bell (Prof. E. T.), Men of Mathematics (*Review*), 525
Bell (Miss Florence O.), appointed research assistant in textile physics in Leeds University, 942
Bellingham (L.), A Double Refraction Effect in Certain Fatty Materials, 70
Beltrán (Prof. J. R.), appointed professor of the history of medicine at Buenos Aires University, 641
Belz (M. H.), [J. H. Michell and], The Elements of Mathematical Analysis. 2 Vols. (*Review*), 631
Benjamin (Dr. M.), and R. O. Jenkins, Surface migration of Barium, 152
Benndorf (H.), and M. Mitlacher, Stationary Air Currents in Closed Vessels, 1112
Bennett (Miss A.), Plant Ecology of Limestone Pavements, 731
Benson (Dr. E.), Grammar Schools and Technical Education, 79
Bentsáth (A.), and Prof. A. Szent-Györgyi, Vitamin P, 426
Berg (Dr. W. F.), Mechanism of the Photographic Process, 997
Bergel (Dr. F.), [Dr. A. R. Todd, H. Waldmann, T. S. Work and], Constituents of Vitamin E Concentrates from Rice- and Wheat-Germ Oils, 361
Bergey (Prof. D. H.), [death], 576
Bernal (J. D.), appointed professor of physics at Birkbeck College, 904
Bernard (R.), Spectrum of Nitrogen and Atmospheric Pressure at High Altitudes, 930
Bernstein (R. E.), Excretion of Vitamin C in Sweat, 684
Berthelsen (H.), [A. Hjärre and], Method for Fixing Neutral-Red in Supra-Vital Stained Blood Smears, 155
Bertrand (G.), Presence and Distribution of Boron in the Potash Salts of Alsace, 820
Bertrand (P.), Comparative Ontogeny of Living and Fossil Phanerogams, 1111
Best (R. J.), Artificially Prepared Visible Paracrystalline Fibres of Tobacco Mosaic Virus Nucleoprotein, 547
Bevin (E.), Trades Union Congress and Science, 457
Bewley (Dr. W. F.), Science in Relation to the Glasshouse Industry, 887
Beyling (Dr. C.), awarded the medal of the Institution of Mining Engineers, 967
Bhabha (Dr. H. J.), awarded an 1851 exhibition studentship, 38
Bhagavantam (Prof. S.), and B. Sundara Rama Rao, Adiabatic and Isothermal Compressibilities of Heavy Water, 1099
Bhatnagar (Prof. S. S.), Dr. H. Lersheim and Mohan Lal Khanna, The Ground State of the Se_2 Molecule, 152
Bialinycki-Birula (Dr. A. A.), [death], 97
Bieling (Prof. R.) and others, Die europäischen und mediterranen Ottern und ihre Gifte: Grundlagen zur Darstellung eines wirksamen Schlangenserums (*Review*), 744
Bilger (G.), Potential of Polygons and Elementary Geometry, 376
Bilham (E. G.), Effects of Obstacles on Sunshine Records, 648; Weather and Water Supplies, 964
Biquard (Dr. P.), The Palace of Discovery at the Paris International Exhibition, 1937, 328
Birch (A. J.), Detection and Estimation of α-Phellandrene in Essential Oils, 377
Birch (Prof. de Burgh), [death], 536; [obituary article], 715
Biswas (K. P.), Aquatic and Marsh Plants of India and Burma, 592
Bizette (H.), and B. Tsai, Magnetic Rotatory Power of Compressed and of Liquefied Nitric Oxide, NO, 208
Black (M.), appointed a demonstrator in geology in Cambridge University, 123
Black (Prof. N. H.), New Laboratory Experiments in Practical Chemistry (*Review*), 173; and J. B. Conant, New Practical Chemistry: Fundamental Principles Applied to Modern Life (*Review*), 173
Blackett (Prof. P. M. S.), appointed Langworthy professor of physics in Manchester University, 207; work of, 962
Blackman (Dr. F. F.), presentation of a portrait of, to the Botany School, Cambridge, 845
Blackman (Prof. V. H.), conferment upon, of the title of emeritus professor by London University, 778
Blacktin (Dr. S. C.), Spontaneous Electrical Charge of Fine Coal Dust, 280; Electrotor Smoke and Dust Meter, 331, 582; New Inventions Exhibition, 982; awarded the Founder's silver medal and the Institute of Patentees' silver medal, 1058
Blackwell (Miss Elizabeth), Germination of Resistant Spores of *Blastocladia Pringsheimii*, 933
Blair (Dr. G. W. Scott), appointed head of the chemistry department of the National Institute for Research in Dairying, 61; 654
Blanc (G.), and M. Baltazard, Crossed Immunity between the Pustular Fever and Purpura Fever of the Rocky Mountains, 905
Blatter (late Rev. E.), and W. S. Millard, Some Beautiful Indian Trees (*Review*), 633
Blau (Dr. Marietta), and Dr. Hertha Wambacher, Measurement of the Length of Proton Tracks by the Photographic Method, 252; awarded the Ignaz L. Lieben prize of the Vienna Academy of Sciences, 332; Disintegration Processes by Cosmic Rays with the Simultaneous Emission of Several Heavy Particles, 585
Bless (A. A.), Effects of the Length of X-Ray Waves on Seeds, 83
Blodgett (K. B.), and I. Langmuir, Built-up Molecular Films, 470
Bodson (H.), [J. Timmermans and], Surface Tension of Water and that of Heavy Water, 293
Bogert (Prof. L. J.), Dietetics Simplified: the Use of Foods in Health and Disease. With Laboratory Section by M. T. Porter (*Review*), 829
Böhnecke (G.), Temperatur, Salzgehalt und Dichte an der Oberfläche des atlantischen Ozeans. Lief. 1; Atlas (*Review*), 704
Bohr (Prof. Niels), Lord Rutherford, 752; 1048
Bois (Prof. D.), Les plantes alimentaires chez tous les peuples et à travers les ages: histoire, utilisation, culture. Vol. 4. (*Review*), 787
Bolland (J. L.), and Dr. H. W. Melville, Analysis of Ternary Gas Mixtures by Thermal Conductivity Measurements, 63
Bolliger (A.), Compounds of Creatinine with Alkaline Hydroxides, 377; Red Compounds formed by Picric Acid and Creatinine in the Presence of Sodium Hydroxide, 519
Bomke (Dr. H.), Vakuumspectroskopie (*Review*), 528
Bond (C. J.), Biology and the New Physics: a Plea for a consistent Philosophy of Life (*Review*), 953
Bond (Dr. G.), Excretion of Nitrogen by Leguminous Plants, 683
Bond (Dr. W. N.), [obituary article], 716
Bonét-Maury (P.), Utilization of Photo-Elements with Semi-Conducting Layer for Radioactive Measurements, 208; Optical Properties of Bacterial Suspensions, 985
Bonhoeffer and Fredenhagen, Cannizzaro Reaction, 369
Booth (F. A.), [L. C. Beadle and], An Inexpensive Low-Temperature Thermostat, 279
Bordet (Prof. J.), awarded the Grand Cross of the Order of Leopold, 104
Borocco (A.), [L. Hackspill and], Compounds of the Isotope 2 of Hydrogen with the Alkali Metals (Alkaline Deuterides), 82
Bosch (Prof. C.), elected president of the Kaiser Wilhelm Society for the Advancement of Science, 274
Bose (Prof. D. M.), Absorption Spectra Evidence of the Decomposition of the Ground Term of Nd^{+++} Ion due to Crystalline Fields, 109
Bose (Sir Jagadis Chandra), [death], 922; [obituary article], 1041

Bose (Dr. S. R.), Polyporaceous Fungi, 592; and S. N. Sarkar, Enzymes of Wood-Rotting Polypores, 813

Bosler (J.), and H. Roure, Disappearance of Biéla's Comet, 40

Botha (Lt.-Col. C. G.), Science of Archives in South Africa, 374

Bouchard (Charles), (1837–1915), work of, 457

Bouckaert (Prof. J. J.), awarded the Gluge prize of physiology of the Belgian Royal Academy of Sciences, 274

Boulenger (Dr. G. A.), [death], 960

Bourdouil (Mme. C. Sosa), Composition of the Pollen of Some Ranunculaceæ and on their Systematic Position, 656

Boutry (G. A.), and G. Tréherne, Commutable and Stable Electrical Contacts, 251

Bowen (E. G.), [R. A. Watson-Watt, A. F. Wilkins and], Reflection of Radio Waves in the Atmosphere, 512

Bowen (Prof. I. S.), Prof. R. A. Millikan and Dr. H. V. Neher, Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts, 23

Bowen (Prof. N. L.), elected a foreign correspondent of the Geological Society of London, 883; work of, 884

Bowman (J.), awarded a Royal Asiatic Society's Universities Essay prize, 967

Boyd (J. D.), appointed lecturer in anatomy in Cambridge University, 123

Boyes (J. W.), and W. P. Thompson, Endosperm and Embryo in Reciprocal Cereal Crosses, 511

Boys (Sir Charles Vernon), Weeds, Weeds, Weeds (*Review*), 994

Bradley (A. J.), H. J. Goldschmidt, H. Lipson and A. Taylor, Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays, 543; and A. Taylor, An X-Ray Investigation of the cause of High Coercivity in Iron-Nickel-Aluminium Alloys, 1012; and H. Lipson, Rapid Survey of Ternary Alloy Systems by X-Rays, 1069

Bradley (Dr. O. C.), [death], 1043

Bragg (Sir William), elected an honorary associate of the Royal Institute of British Architects, 21; conferment upon, of an honorary doctorate by Edinburgh University, 80; Lord Rutherford, 752; recommended for re-election as president of the Royal Society, 840; appointed a member of the advisory council to the Committee of the Privy Council for Scientific and Industrial Research, 888; The Grain-like Structure of Solids, 954; The Pilgrim Trust Lecture, 961

Bragg (Prof. W. L.), *Atomic Structure of Minerals* (George Fisher Baker lecture) (*Review*), 783

Braun (A.), Dr. P. Preiswerk and P. Scherrer, Detection of α-Particles in the Disintegration of Thorium, 682

Braunstein (Prof. A. E.), Specificity of the Salicylic Aldehyde Reaction of Csonka-Straub, 427; and M. G. Kritzmann, Formation and Breakdown of Amino-Acids by Intermolecular Transfer of the Amino Group, 503

Breen (J.), J. Keane and T. J. Nolan, Chemical Constituents of Lichens found in Ireland—*Pertusaria concreta*, 333

Brenchley (Dr. Winifred E.), Pasture Problems, 918

Brewster (A. B.), [obituary article], 881

Brickwedde (F. G.), [R. B. Scott and], Liquid Parahydrogen, 1020

Bridgman (Prof. P. W.), Polymorphic Transitions of Inorganic Compounds to 50,000 kgm./cm.^{2}, 83; Polymorphism under Pressure, 899

Briegleb (Dr. G.), and W. Lauppe, Raman Spectra of Oxonium Compounds, 236

Briggs (G. E.), [J. G. Bald and], Aggregation of Virus Particles, 111

Briggs (L. J.), Standardization of Physical Units, 122

Bright (Sir Charles), [death], 1002

Brightman (R.), Reflections on Life (*Review*), 341; Social Theory and Discipline (*Review*), 481

Brindley (Dr. G. W.), and P. Ridley, Asymmetry in Metals of Hexagonal Structure, 461

Briner (E.), [D. Monnier, B. Susz and], Raman Spectra of Acrylic Acid and of Methyl Methacrylate, both Monomer and Polymerized, 737; and E. Perrottet, Complementary Results on the Catalytic Action of Ozone in the Oxidation of Aldehydes, 737

Briscoe (Prof. H. V. A.), Dust Control in Industry, 773; Intermediate Chemistry (*Review*), 910

Brocket (Lord), gift of Devil's Dyke, Wheathampstead, as an open space, 764

Brockway (L. O.), [L. Pauling and], Carbon-Carbon Bond Distances, 688

de Broglie (Duc), Lord Rutherford, 1050

Brohult (S.), Splitting of the Hæmocyanin Molecule by Ultra-Sonic Waves, 805

Broniewski (W.), S. Przedpolski and S. Sulowski, Some Physical and Chemical Properties of Very Pure Steels, 334

Brooke (G. B.), and A. G. Waddington, Determination of Alumina in Metallic Aluminium, 858

Brooks (C. F.), and A. H. Tiessen, Meteorology of Great Floods in the Eastern United States, 511

Broom (Dr. R.), Discovery of a Lower Molar of *Australopithecus*, 681

Brown (A. B.), and R. G. H. Cormack, Heteroauxin and Cambial Activity, 898

Brown (A. G.), [M. B. Crane and], Incompatibility and Sterility in Sweet Cherries, 1019

Brown (Dr. D.), Sound-Films as Diffraction Gratings for Visual Fourier Analysis of Sound-Waves, 1099

Brown (J. M.), appointed lecturer in political science in the United College, St. Andrews University, 207

Brown (L. W.), [Dr. F. W. G. White and], Annual Variation of the Absorption of Wireless Waves in the Ionosphere, 931

Brown (Prof. P. E.), [death], 226

Brown (R. S.), Anatomy of *Ophelia cluthensis* McGuire, 292

Browne (E. T.), [death], 1043

Bruce (E. L.), Gold Deposits of the Canadian Shield, 116

Bruce (M. M.), Utilization of Leisure, 229

Brück (Dr. H.), appointed first junior observer in the Cambridge Solar Physics Observatory, 819

Brunner (Dr. O.), awarded the Rudolf Wegscheider prize of the Vienna Academy of Sciences, 332

Brunowsky (B. K.), [Prof. W. I. Vernadsky, C. G. Kunasheva and], Concentration of Mesothorium-1 by Duckweed (*Lemna*), 317

Brunt (Prof. D.), and others, Investigation of the Upper Air, 876

de Bruyne (Dr. N. A.), awarded the Simms gold medal of the Royal Aeronautical Society, 1094

Budden (K. G.), and J. A. Ratcliffe, An Effect of Catastrophic Ionospheric Disturbances on Low-frequency Radio Waves, 1060

Buffle (J. P.), Origin of the Calcium Bicarbonate in the Waters of the River Versoix (Canton of Geneva), 125

Builder (Dr. G.), [Dr. A. L. Green and], Control of Wireless Signal Variations, 76

Bull (Dr. H. B.), The Biochemistry of the Lipids (*Review*), 787

Bull (L.), and P. Girard, Influence of Electric and Magnetic Fields on the Electric Spark in Air at Atmospheric Pressure, 1111

Buller (Prof. A. H. R.), awarded a Royal medal of the Royal Society, 840; presented with a Royal medal of the Royal Society; work of, 980

Bullock (W.), Gold Mining with the Aid of Aeroplanes, 100

Bulman (Dr. O. M. B.), appointed lecturer in palæozoology in Cambridge University, 123

Bunting (E. N.), [R. F. Geller and], Lead Borates, 34

Burchell (J. P. T.), Pottery in the Palæolithic Period, 800

Burg (A. B.), and H. I. Schlesinger, Borine Carbonyl, 74

Burgess (A. H.), Drying of Plant Materials, 1104

Burn (Prof. J. H.), appointed professor of pharmacology in Oxford University; work of, 227; elected a professorial fellow of Balliol College, Oxford, 694

Burn (W. S.), Development of the Two-Stroke Cycle Oil Engine, 597

Burnham (J.), [P. C. Cross, P. A. Leighton and], Structure of Water, 512
Burnous (E. G.), Ethnology of Wallis Island, 812
Burton (Prof. E. F.), Refractive Indexes of Helium I and II, 1015
Bushnell, jun. (D. I.), Early Indian Sites in Virginia, U.S.A., 854
Butenandt (Dr. A.), awarded the Scheele medal of the Chemical Society of Stockholm, 274
Butler (Dr. N. Murray), conferment upon, of an honorary doctorate by Edinburgh University, 80
Buzzard (Sir E. Farquhar), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
Byerly (Prof.), Earthquakes off the Coast of Northern California, 937
Byng (E. S.), and G. A. Robinson, Education in Industrial Management, 79
Byron (R.), The Road to Oxiana (*Review*), 788

Cadbury (Edward), conferment upon, of an honorary doctorate by Birmingham University, 80
Cady (Prof. W. G.), awarded the Duddell medal of the Physical Society; work of, 55
Caie (J. M.), State Intervention in Agriculture, 416
Cajal (Santiago Ramón y), Translated by Prof. E. H. Craigie, with the assistance of Prof. J. Cano, Recollections of My Life (*Review*), 617
Calman (Dr. W. T.), conferment upon, of an honorary doctorate by St. Andrews University, 694
Cameron (Dr. G. R.), conferment upon, of the title of professor by London University, 207
Cameron (T. W. M.), *Life-History of Apophallus venustus*, 510
Camm (G. L.), awarded the senior mathematical scholarship of Oxford University, 38
Campbell (D.), Electric Furnaces, 59
Campbell (Sir Malcolm), Motor-boat Speed Record, 460
Campbell (Dr. N. R.), Measurement of Radiant Energy (*Review*), 828
Camsell (C.), Mining Industry of Canada, 542
Candler (A. C.), Atomic Spectra and the Vector Model. 2 Vols. (*Review*), 626
Cannon (D. A.), awarded a Medical Research Council junior research fellowship in tropical medicine, 274
Capdecomme (L.), and P. Jacquet, Reflecting Power of Copper, 40
Capstick (Dr. J. W.), [obituary article], 225
Carey (Isabella P.), [J. Algar and], Synthesis of Flavonols: Oxidation of Flavindogenides, 292
Carpenter (F. M.), Fossil Insects from Kansas Rocks, 116
Carpenter (Prof. G. D. Hale), Attitude and Concealing Coloration, 684; Wild Birds and Butterflies, 974
Carpenter (Sir Harold), awarded the Carl Lueg gold medal of the Verein deutscher Eisenhüttenleute; work of, 675
Carr (Dr. Emma R.), awarded the Francis B. Garvan gold medal of the American Chemical Society, 888
Carr (Dr. F. H.), elected president of the Association of British Chemical Manufacturers, 719
Carrisson (G.), Rapid Counting of a Microbial Suspension, 376
Carroll (Prof. J. A.), Method of Determining Stellar Rotation, 162
Cartan (Prof. E.), Rédigées par Dr. P. Vincensini, Leçons sur la théorie des espaces à connexion projective (*Review*), 950; appointed Rouse Ball lecturer in Cambridge University for 1937–38, 1026
Carter (Major B. C.), and A. G. Pugsley, awarded the Edward Busk memorial prize of the Royal Aeronautical Society, 1094
Carter (Dr. G. S.), appointed a lecturer in zoology in Cambridge University, 904
Cathcart (E. B.), [Dr. K. G. Emeléus, C. M. Minnis and], Electrical and Optical Properties of Iodine Vapour, 251
Cave (Dr. A. J. E.), Human Skeletal Remains in London, 497
Cavell (A. C.), [late Prof. T. M. Lowry and], Intermediate Chemistry (*Review*), 910
Cawston (F. G.), Development of Teeth in the Radula of Fresh Water Mollusca; South African larval Trematodes with Forked Tails, 1028
Cayeux (L.), New Data on the Existence of Bacteria in the Old Sedimentary Rocks, 124
Čeřovská (Miss J.), Circular Ultra-Sonic Grating in Liquids, 425
Chadwick (Sir David), elected an honorary fellow of Sidney Sussex College, Cambridge, 38, 80
Chadwick (Prof. J.), Lord Rutherford, 749
Champion (Dr. F. C.), and A. Barber, Production of Positron and Electron Pairs by Bombardment of Mercury with β-Particles of Low Energy, 105
Chao (C. Y.), and T. H. Wang, Spacing of the Resonance Neutron Levels of Silver, Rhodium and Bromine Nuclei, 768
Chaplin (H. O.), [Dr. L. Hunter and], Evidence of Restricted Rotation about the N-C Bond in 2 : 6-Disubstituted Acetanilides, 896
Chapman (F.), National Museums of Natural History, 272
Chapman (Prof. S.), Cosmic Rays and Magnetic Storms, 423; appointed a member of the Cambridge University Committee for Geodesy and Geophysics, 1026
Chapman (V. J.), A Dune Drainage System, 592
Charlesworth (Prof. J. K.), Map of the Glacier Lakes and Local Glaciers of the Wicklow Hills, 251; 977
Charpy (G.), Determination of Silicon in Steels, 820
Chasen (F. N.), [late H. C. Robinson and], The Birds of the Malay Peninsula. Vol. 3: Sporting Birds; Birds of the Shore and Estuaries (*Review*), 1034
Chatterjee (Prof. B. C.), The Hydro-electric Practice in India. 2 Vols. (*Review*), 442
Chenery (E. M.), Colour of Hydrangea Flowers, 326
Childs (Dr. E. C.), The Function of Experiment, 852
Childs (S. W.), gift by, to Yale University for cancer research, 21
China (W. E.), [I. W. Helmsing and], Hemipterous Insects of the Family Peloridiidæ, 326
v. Cholnsky (Dr. L.), [Prof. L. Zechmeister und], Die Chromatographische Adsorptionsmethode: Grundlagen, Methodik, Anwendungen (*Review*), 48
Chrétien (A.), and J. Kraft, Uranyl Phosphites, 251
Church (Dr. A. H.), [obituary article], 268
Churcher (B. G.), and A. J. King, Performance of Noise Meters in Terms of the Primary Standard, 331
Cimerman (C.), and P. Wenger, Micro-separation of Zinc by Means of *o*-Oxyquinoline in Acetic Solution; Volumetric Micro-estimation of Zinc in Alkaline Solution, 737
Clark (A. J.), and J. Raventos, Pharmacology of Tetramethylammonium, 325
Clark (E. Graham), appointed secretary to the Institution of Civil Engineers, 1058
Clark (Frances N.), Interseasonal and Intraseasonal Changes in the Size of the California Sardine; Fishing Localities for the California Sardine, 858
Clark (G. L.), elected an Isaac Newton student of Cambridge University, 904
Clarke (Dr. J. G. D.), Mesolithic Site in Surrey, 144
Clarke (S. H.), Gurjun, Apitong, Kerning, Kapur and Allied Timbers, 326
Claus (W. D.), [A. Hollaender and], Problem of Mitogenetic Radiation, 1007
Clay (J.), and G. van Kleef, Conductivity of Pure Gases at High Pressures, 1111
Clayton (Dr. A. E.), Validity of Laws of Electrodynamics, 246
Clegg (Dr. H. A.), [Dr. C. Hill and], What is Osteopathy? (*Review*), 788
Clifford (F. W.), A Census of Periodicals (*Review*), 786
Clifton (Dr. C. E.), Prevention of Assimilation in Respiring Cells, 318
Cline (J. K.), R. R. Williams and J. Finkelstein, Synthesis of Vitamin B_1, 856
Clinton (Dr. G. P.), [death], 393
Cloassen (Prof. P. W.), [death], 455

Clouston (Flying Officer A. E.), and Mrs. Kirby-Green, New Flying Speed Records, 888, 929
Cochrane (Flora), Histological Analysis of Eye Pigment Development in *Drosophila pseudo-obscura*, 292
Cockerell (Prof. T. D. A.), Zoological Nomenclature, 27
Cockerham (Dr. G.), Potato Flowers and Dissemination of Potato Viruses, 1100
Cocking (W. T.), Wireless Servicing Manual. Third edition (*Review*), 914
Codos (M.), and others, Flying Speed Record, 929
Colas [Raymond Hamet and], Botanical Origin of the Chuchuhuasha, 334
Cole (F. C.), Petrofabric Study of Moine Schists, 429
Cole (H. A.), Breeding of Oysters in Tanks, 854
Cole (L. W. L.), [Capt. H. Barkworth and], Acidosis and Off-flavoured Milk, 324
Cole (Dr. R.), retirement of, from the directorship of the Hospital of the Rockefeller Institute for Medical Research, 104
Collinge (Dr. W. E.), Wild Birds and Butterflies, 974
Collins (Prof. H. H.), [death], 576
Collins (Prof. H. J.), and C. A. Hart, Principles of Road Engineering (*Review*), 441
Collins (Dr. Mary), Rabkin's Polychromatic Plates for Color Sense Examination (*Review*), 49; Tests for Colour Defects, 414; 532; 569
Comrie (Dr. L. J.), Dr. J. R. Airey, 796
Conant (J. B.), [Prof. N. H. Black and], New Practical Chemistry; Fundamental Principles Applied to Modern Life (*Review*), 173
Cone (W. H.), and H. V. Tartar, Passivity of Iron, 117
Conn (G. K. T.), [Dr. G. B. B. M. Sutherland and], Infrared Spectrum of Tetradeuteroethylene, 644
Constable (Dr. J. E. R.), Science in Everyday Life, 457
Conway (Prof. E. J.), Structural Laws of the Mammalian Kidney with Theoretical Derivations, 40; J. M. O'Connor and D. K. O'Donovan, Influence of Temperature on the Activity of the Kidney in Relation to its Influence on Oxygen Consumption, 40
Cook (F. C.), and others, Road Design and Road Safety, 650
Cook (S. F.), [K. G. Scott and], Effect of Radioactive Phosphorus upon the Blood of Growing Chicks, 293; K. G. Scott and P. Abelson, Deposition of Radiophosphorus in Tissues of Growing Chicks, 944
Cook (Dr. W. R. I.), [C. C. Hentschel and], Biology for Medical Students. Second edition (*Review*), 994
Cooke (Mary Thacher), Speed of Flight of Birds, 325
Cooper (C. Forster), Middle Devonian Fish Fauna of Achanarras, 292; appointed director of the British Museum (Natural History), 967
Copenhagen (W. J.), Sulphur as a Factor in the Corrosion of Iron and Steel Structures in the Sea (2), 1028
Corbet (R. E.), [H. N. Holmes and], Crystalline Vitamin A, 1020
Cormack (R. G. H.), [A. B. Brown and], Heteroauxin and Cambial Activity, 898
Cornes (J. J. S.), Attitude and Concealing Coloration, 684
Cornish (Dr. Vaughan), Borderlands of Language in Europe: and their relation to the Historic Frontier of Christendom (*Review*), 994; Apparent Enlargement of the Sun at the time of Rising and Setting, 1082
Cortis-Jones (B.), [Dr. R. Lemberg, M. Norrie and], An Oxyporphyrin Hæmatin Compound as Intermediate between Protohæmatin and Verdohæmatin, 65
Corwin (W.), [J. W. Thompson, J. H. Aste-Salazar and], Physiological Patterns and Mental Disturbances, 1062
Costello (D. P.), awarded the Royal Asiatic Society's Universities Essay prize, 967
Cosyns (M.), Belgian Stratosphere Balloon Experiment, 54; Abnormal Zenithal Distribution of Cosmic Rays, 931
Cotter (J. L.), Extinct Mammals and Man in America, 243
Cotton (R. T.), and N. E. Good, Insects and Mites in Stored Grain, 936
Coursey (P. R.), Electrolytic Condensers: their Properties, Design and Practical Uses (*Review*), 636
Cousty (J.), Diamagnetism of Solutions of Iodine and the Purity of the Alcohol, 518
Cowles (W. H. H.), and J. E. Thompson, A Text Book of Trigonometry: for Colleges and Engineering Schools (*Review*), 344
Cowley (E. G.), and Prof. J. R. Partington, Series Effect on the Dipole Moments of some Alkyl Halides, 1100
Cowling (T. G.), appointed lecturer in mathematics in University College, Dundee, 38
Cox (E. G.), [F. J. Llewellyn, T. H. Goodwin and], Crystalline Structure of Pentaerythritol, 430
Cox (E. W.), The Evolution of the Australian Merino (*Review*), 870
Crane (H. R.), [D. S. Bayley and], The β-Rays from Lithium and Boron Isotopes, 776; [J. J. Turin and], The β-Rays from Lithium and Boron Isotopes, 776
Crane (M. B.), and A. G. Brown, Incompatibility and Sterility in Sweet Cherries, 1019
Crawley (C. W. B.), [obituary article], 1002
Crew (Prof. F. A. E.), Selective Action of Mortality, 410; The Sex Ratio, 449; Sex Ratio in the Domestic Fowl and its Bearing upon the Sex-linked Lethal Theory of Differential Mortality, 1027; and C. Auerbach, 'Spheroidal': a Mutant in *Drosophila funebris* affecting Egg Size and Shape, and Fecundity, 124; and Dr. C. Auerbach, New Mutation in *Drosophila*, 898; and others, The Sex-Ratio, 958; and S. S. Munro, Gynandromorphism and Lateral Asymmetry in Birds, 1027
Croll (R. H.), Wide Horizons: Wanderings in Central Australia (*Review*), 1081
Crommelin (Dr. A. C. D.), presented with the Walter Goodacre gold medal and gift of the British Astronomical Association, 800; [Mary Proctor and], Comets: their Nature, Origin and Place in the Science of Astronomy (*Review*), 506
Crosland (L.), Higher School Revision Mathematics (*Review*), 7
Cross (E. J.), and Prof. F. M. Rowe, Prof. A. G. Perkin, 13
Cross (P. C.), J. Burnham and P. A. Leighton, Structure of Water, 512
Crouzon (Dr.), appointed professor of social medicine in the Paris Faculty of Medicine, 929
Crowfoot (Dr. D.), The Two Crystalline Modifications of Insulin, 149
Crowther (H.), [death], 1002
Crowther (Prof. J. A.), and H. Liebmann, An Effect of X-Radiation on the ξ Potential of Colloidal Graphite, 28; Biological Action of X-Rays: a Theoretical Review (Silvanus Thompson memorial lecture), 1069
Crowther (J. G.), Famous American Men of Science (*Review*), 439; Congrès du Palais de la Découverte, International Meeting in Paris: Physics, 710
Crozier (W. J.), [A. H. Holway and], Law of Minimal Discrimination of Intensities (2), 943; E. Wolf and Gertrud Zerrahn-Wolf, Specific Constants for Visual Excitation, 943
Cullis (Prof. C. G.), retirement of; work of, 185
Cumming (Dr. W. M.), [death], 309
Cummins (G. B.), [J. C. Arthur and], Rust Fungi of the Philippines, 648
Cunningham (Dr. B.), River Flow Around Bends, 728; Estuary Channels and Embankments (Vernon-Harcourt lecture), 1046; Inland Water Survey in Great Britain, 1106
Curme, jun. (Dr. G. O.), Recent Progress in Synthetic Organic Chemistry, 901
Curzon (H. H.), and R. W. Thornton, South African Native Cattle, 551
Cushing (Prof. H.), [Prof. J. F. Fulton and], A Bibliographical Study of the Galvani and the Aldini Writings on Animal Electricity, 840
Cuthbertson (Prof. A. C.), G. Gee and Prof. E. K. Rideal, The Kinetics of Polymerization, 889
Cuthbertson (J. W.), Young's Modulus Apparatus, 511
Cutler (D. Ward), and Miss Mabel Dunkley, Standardization of Potato Slopes for Bacteriological Tests, 1015

Dale (Sir Henry), awarded the Copley medal of the Royal Society, 840; presented with the Copley medal of the Royal Society; work of, 979

Dalén (Dr. N. G.), [death], 1087

Dales (J. L.), awarded a Medical Research Council junior research fellowship in tropical medicine, 274

Dalling (Prof. T.), conferment on, of a degree by Cambridge University, 778

Dalzell (Dr. J. Moir), Practical Stereoscopic Photography (*Review*), 528

Dandekar (S. B.), Lectures on College Algebra (*Review*), 831

Dannatt (C. W.), appointed reader in metallurgy at the Imperial College—Royal School of Mines, 942

Danzer (Dr.), Birth Policy and the Problem of Space, 678

Darlington (Dr. C. D.), The Biology of Crossing-over, 759; Interaction between Cell Nucleus and Cytoplasm, 932; Recent Advances in Cytology. Second edition (*Review*), 1033

Daunt (J. G.), awarded the Scott scholarship for research in physics of Oxford University, 819

Dauvillier (A.), A Universal Counter, 477

Davenport (H.), appointed an assistant lecturer in mathematics in Manchester University, 207

Davenport (R. W.), The Ohio-Mississippi Floods of 1937, 666

Davey (D. G.), Physiology of Nematodes, 645

David (Prof. W. T.), and B. Pugh, Influence of Hydrogen and Water Vapour upon the Combustion of Carbon Monoxide Mixtures, 1098

Davidson (Dr. J.), Bioclimatic Zones of Australia, 265

Davidson (Rev. Dr. M.), Comets and Problems of Cosmogony, 799; Free Will or Determinism? (*Review*), 871

Davies (Dr. A. Morley), Evolution and its Modern Critics (*Review*), 912

Davies (E. R.), Action of Light on Photographic Materials, 997

Davies (Dr. G. R.), [Sir Gilbert Morgan and], Preparation of Germanium and Gallium, 688

Davies (J. D. G.), appointed assistant secretary of the Royal Society, 460

Davies (Dr. R. D.), elected a research fellow of Christ's College, Cambridge, 38

Davis (Dr. A. H.), Noise (*Review*), 637

Davis (H. T.), The Theory of Linear Operators: from the Standpoint of Differential Equations of Infinite Order (*Review*), 174

Davison (E. H.), Field Tests for Minerals (*Review*), 830

Davisson (Dr. C. J.), awarded, with Prof. G. P. Thomson, the Nobel prize for physics; work of, 882

Davson, Bt. (Sir Edward), [death], 268

Davy (M. J. B.), Interpretative History of Flight (*Review*), 637

Dawson (Sir Philip), Co-ordination of Fuel Interests, 763

Daymond (J. R.), Run-off after Rainstorms, 470

Debierne (A.), A New Mode of Transformation, 518; and L. Goldstein, New Transformations Produced at Low Temperatures (*frigadreactions*), 656

Debiesse (J.), Absorption Spectra of Microbial Broths, 985

De Donder (Prof. T.), and Prof. P. Van Rysselberghe, Thermodynamic Theory of Affinity: a Book of Principles (*Review*), 344

Degerbøl (M.), and others, Greenland Culture (2), The Eskimo, 177

Delaplace (R.), Vapour Pressure of Gaseous Saturated Hydrocarbons at Low Temperatures in the Presence of Silica Gel, 435; Pressure of some Permanent Gases at Low Temperatures in the Presence of Silica Gel, 985

Delépine (M.), and A. Horeau, Catalysis of the Cannizzaro Reaction by Active Nickel and Platinum, 208

Delfosse (Dr. J.), [Prof. M. de Hemptinne, J. Jungers and], Raman Spectra of Deuteroethylenes, 323

Dellinger (Dr. J. H.), Ionosphere Disturbances, 732

Delorme (G.), [P. Riou, H. Gamelin and], Distribution of Manganese and Iron in the Conifers of Quebec Province, 1027

Demassieux (Mme. Nathalie), and B. Federoff, Dehydration of the Double Sulphate of Copper and Potassium, 778

Demerec (M.), [H. Fricke and], Influence of Wave-length on Genetic Effects of X-Rays, 519; [B. P. Kaufmann and], Frequency of Induced Breaks in Chromosomes of *Drosophila melanogaster*, 943

Demmelmair (A.), [Prof. V. F. Hess and], World-wide Effect in Cosmic Ray Intensity, as Observed During a Recent Magnetic Storm, 316

Dennell (R.), Feeding Mechanism of *Apseudes*, 469

Dent (Prof. Alberta), [Mary T. Dowd and], Elements of Foods and Nutrition (*Review*), 829

Deodhar (Dr. G. B.), Introduction to Optics (*Review*), 216

Desnuelle (P.), [Prof. P. Kuhn and], Protein of Yellow Enzyme, 936

Desveaux (R.), [M. Lemoigne, P. Monguillon and], Reduction of Nitric Acid to Hydroxylamine by the Higher Plants, 293

Des Vœux (Dr. H. A.), Idealism, 691

Dew (Dr. R. Elsdon), Races with a High Proportion of Blood Group *AB*, 1066; Bantu Blood Groups, 77; Blood Groups in Central Africa, 927

Dewan (J. G.), and D. E. Green, A New Oxidation Catalyst, 1097

Dewar (J.), appointed lecturer in chemistry in the United College, St. Andrews University, 38

Dewey (H.), Lower Greensand and Water Supply, 963

Dewrance (Sir John), [death], 716

Dhar (Prof. N. R.), Chemical Stabilization (*Review*), 340; Light in the Service of Man (*Review*), 444

Diamond (J.), appointed a demonstrator in engineering in Cambridge University, 476

Dible (Prof. J. H.), appointed professor of pathology at the British Postgraduate Medical School, 166

Dickinson (Dr. H. C.), Enforcement of the Rules of the Road, 580

Dickson (H.), A Short Periodic Growth Cycle and a Secular Variation in *Lemna minor*, 112

Diebold (R.), [A. Travers and], Isolation of Pure Cementite by Acid Attack of Ferrous Materials, etc., 1073

Dietz [Fischer, Jübermann and], Separation of the Rare Earths, 74

Dingle (Dr. H.), Judgment by Hypothesis, 589; Science and the Unobservable, 963

Divers (Dr. Edward), centenary of the birth of; work of, 924

Dixon (Prof. A. L.), Prof. E. B. Elliott, 267

Dixon (J. K.), Cobalt Chloride Treatment of Sheep, 898

Dixon (Prof. S. M.), G. Fitzgibbon and Dr. M. A. Hogan, Hydrography of the River Severn, 73

Dixon (Dr. W. M.), Action of Iodoacetate on Dehydrogenases and Alcoholic Fermentation, 806

Dixon-Scott (J.), England under Trust: the Principal Properties held by the National Trust in England and Wales (*Review*), 623

Dobson (Dr. G. M. B.), appointed a member of the Advisory Council to the Privy Council for Scientific and Industrial Research, 680; elected an official fellow of Merton College, Oxford, 694; awarded the Symons gold medal of the Royal Meteorological Society, 929

Dobzhansky (Prof. T.), Exposés de génétique, 2: L'Effet de position et la théorie de l'hérédité (*Review*), 788

Dodd (Prof. E. L.), and Dr. J. Neyman, An International Conference on the Theory of Probability, 938

Dodds (Prof. E. C.), Pituitary Extracts and Gastric Ulcers, 159; M. E. H. Fitzgerald and W. Lawson, Œstrogenic Activity of Some Hydrocarbon Derivatives of Ethylene, 772

Dole (Prof. M.), Surface Tension of Strong Electrolytes, 464

Doniach (Dr. I.), and Dr. J. C. Mottram, Sensitization of the Skin of Mice to Light by Carcinogenic Agents, 588; Photodynamic Action of Carcinogenic Agents, 933

Donisthorpe (H.), Communal Life among Termites (*Review*) 622

Donkin (Bryan), Progress of Engineering, 798

Donnan (Prof. F. G.), conferment upon, of the title of emeritus professor of chemistry by London University, 1110

Dorey (Dr. S. F.), Chemical Intercrystalline Fracture of Riveted Joints in Boilers, 597
Doudoroff (P.), [F. B. Sumner and], Some Quantitative Relations between Visual Stimuli and the Production or Destruction of Melanin in Fishes, 83
Douglas (Dr. A. V.), The Corona by Reflection from the Moon, 156
Dowd (Prof. J.), Control in Human Societies (*Review*), 481
Dowd (Mary T.), and Prof. Alberta Dent, Elements of Foods and Nutrition (*Review*), 829
Dowson (W. J.), and W. A. R. D. Weston, A Disease of Hawthorn, 116
Drioton (Dr.), Bull Cults of Ancient Egypt, 1067
Drysdale (Dr. C. V.), Scientific Basis of Birth Control, 19
Drumm (Dr. P. J.), [Dr. C. P. Stewart, H. Scarborough and], Isolation of Ascorbic Acid from Wine, 282
Duckham (A. N.), Agricultural Marketing Policy, 887
Duclaux (J. P. E.), Anodic Polarization of Tungsten, 208
Duclaux (J.), and M. Amat, Ultra-filters of Carborundum, 656
Dudley (Lord), work of the National Institute of Industrial Psychology, 1088
Duerden (Prof. J. E.), [death], 455; [obituary article], 576
Dufraisse (C.), and J. Le Bras, Combustible Substances, Regarded as Helping Incombustible Extinguishers, for the Practical Extinction of Flames, 905; and J. Houpillart, Dissociable Organic Oxides, 1027
Duggan (Dr. G. H.), elected an honorary member of the Engineering Institute of Canada, 274
Du Mez (Prof. A. G.), [Prof. G. L. Jenkins and], Quantitative Pharmaceutical Chemistry: Containing Theory and Practice of Quantitative Analysis Applied to Pharmacy. Second edition (*Review*), 634
Dunkley (Miss Mabel), [D. Ward Cutler and], Standardization of Potato Slopes for Bacteriological Tests, 1015
Dunlap, jun. (O. E.), Marconi: the Man and his Wireless (*Review*), 260
Dunlop (Miss Margaret), Oolitic Limestone Escarpment in Bronze Age France, 243
Dunlop (W. R.), A Psycho-Geometrical Representation of Personnel Organization, 152
Dunnicliff (Dr. H. B.), Chemistry of Indian Opium, 92
Dunton (W. F.), Validity of Laws of Electrodynamics, 245
Dunworth (J. V.), awarded a Denman Baynes research studentship at Clare College, Cambridge, 435
Durst (C. S.), A West Indian Hurricane, 117
Duthie (Dr. E. S.), resignation from Sheffield University, 735
Du Toit (Dr. P. J.), and Dr. A. I. Malan, Phosphorus and Calcium Deficiency Diseases as Two Œtiologically Distinct Entities, 153
Duval (C.), Cobalt Hydroxides, 985
Du Val (P.), appointed an assistant lecturer in mathematics in Manchester University, 207
Dwyer (Sister Cecilia Marie), [G. S. Sperti, Prof. J. R. Loofbourow and], Proliferation-promoting Substances from Cells Injured by Ultra-Violet Radiation, 643
Dyson (Sir Frank), and Dr. R. v. d. R. Woolley, Eclipses of the Sun and Moon (*Review*), 991

Earl (J. C.), and N. G. Hills, Action of Nitrous Acid on Amines, 1105
Easterfield (T. E.), awarded a Denman Baynes research studentship at Clare College, Cambridge, 435
Eastman (Prof. A. V.), Fundamentals of Vacuum Tubes (*Review*), 953
Eaton (Dr. M. D.), [Prof. F. Urban and], Spectroscopic observations of Reactions between Lactoflavin, the Coulter Compound, 'Cytochrome *b*', and Cytochrome *c*, 466
Eckardt (A.), Production of Artificial Radioactive Elements, 649
Eckersley (T. L.), Irregular Ionic Clouds in the *E* Layer of the Ionosphere, 846
Eddington (Sir Arthur), Relativity Theory of Protons and Electrons (*Review*), 742
Edisbury (Dr. J. R.), Dr. R. A. Morton and G. W. Simpkins, A Possible Vitamin A_2, 234; [Dr. J. A. Lovern, Dr. R. A. Morton and], A New Source of Vitamin A, 276
Edwards (Dr. F. W.), appointed a deputy keeper in the department of entomology of the British Museum (Natural History), 61
Ehrenberg (K.), Two New Remains of Primates from the Miocene of Lower Austria, 125
Ehrenfest, jun. (P.), [P. Auger, A. Freon, Mme. Thérèse Grivet and], Mechanism of the Production of Cosmic Bundles, 292
Einecke (Dr. E.), Das Gallium: Eine Kritische Würdigung der Erkenntnisse mit experimentellen Beiträgen (*Review*), 566
Ellenby (C.), Relation between Body Size and Metabolism, 853
Elias (G.), Deep Well Drilling, 1093
Ellingham (Dr. H. J. T.), appointed reader in physical chemistry at the Imperial College of Science and Technology, 942
Elliott (Prof. E. B.), [death], 184; [obituary article], 267
Elliott (N.), Atomic Distances in Crystals, 978
Ellis (Dr. O. C. de C.), Behaviour of Cylinders of Inflammable Gas in a Fire, 935
Ellison (Capt. F. B.), History of the Hay Railway, 1810–1864, 964
Ellison (M. A.), Observation of a Fireball Train, 244
Ellsworth (J.), Rapid Changes in the Tail of the Finsler Comet, 1937*f*, 985
Elton (A.), and R. Fairthorne, Why Aeroplanes Fly (*Review*), 1035
Emeléus (Prof. K. G.), E. B. Cathcart and C. M. Minnis, Electrical and Optical Properties of Iodine Vapour, 251; and J. Sayers, Negative Ions in Discharge Tubes, 1111
Emerson (Dr. P.), [death], 716
Emmerson (H. C.), and others, Location of Industry, 515
Emslie (S. G.), Gravitational Statics in Three Dimensions, 729; Diffraction of Slow Positive Ions, 463
Endô (H.), and S. Morioka, Magnesium Alloys, 978
England (H. W.), [obituary], 881
Enthoven (R. E.), Indian Ethnography (*Review*), 213
Ephrussi (B.), [G. W. Beadle and], Ovary Transplants in *Drosophila melanogaster*: Meiosis and Crossing-over in Super Females, 779
Epstein (E.), Electrical Precipitation of the Disperse Phase of Organic and Inorganic Dispersoids by Radium Emanation, 1074
Eriksson (H. A. S.), Ionization Energy of Li^+ and He, 151
Erman (Prof. A.), [death], 15; [obituary article], 309
Ernle (Lord), [death], 97
Esnault-Pelterie (R.), Coefficient of Self-inductance of a Solenoid, 1073
Eurich (Dr. F. W.), awarded the medal of the Textile Institute on retirement from the Anthrax Investigation Board for Bradford and District; work of, 675
Evans (D. G.), appointed assistant lecturer in chemistry in the department of bacteriology of Manchester University, 207
Evans (D. S.), awarded a Martin Thackeray studentship at King's College, Cambridge, 435
Evans (G.), and others, Herbage and Forage Seeds, 1018
Evans (H. Muir), Feeding Habits of Pleuronectidæ, 116
Evans (Dr. Joan), Index to the Palace of Minos. With Special Sections Classified in Detail and Chronologically Arranged by Sir Arthur Evans (*Review*), 486
Evans (Dr. J. T.), Mud Fluid for Pressure Drilling Conditions, 202
Evans (P.), Indian Oil Industry, 765; and A. Reid, Drilling Mud, 1025
Evans (Dr. R. D.), presented with the Theobald Smith award in medical science, 460
Evans (Dr. U. R.), Metallic Corrosion, Passivity and Protection (*Review*), 629
Evans-Pritchard (Dr. E. E.), Witchcraft, Oracles and Magic Among the Azande (*Review*), 338
Eve (Prof. A. S.), Lord Rutherford, 336; Interpretation of Atomic Constitution, 1061

Evershed (S.), presentation of a portrait of, to the Institution of Electrical Engineers, 1094
Evershed (W. L.), Quantity Surveying for Builders. Fourth edition (*Review*), 7
Ewald (Dr. P. P.), Electron Diffraction in Crystals, 928
Ewart (Prof. A. J.), [death], 496
Eyston (Capt. G. E. T.), New World Land Speed Record, 929

Fabry (Prof. C.), retirement of; work of, 883
Fahie (W. C.), Galileo and Mathematical Demonstration, 646
Fairbrother (Dr. J. A. V.), High Intensity Light Sources, 552
Fairthorne (R.), [A. Elton and], Why Aeroplanes Fly (*Review*), 1035
Fajans and Martin, Protective Spray Deposits, 511
Falconer (Prof. A. W.), appointed principal and vice-chancellor of Cape Town University, 476
Falconer (Dr. J. D.), Darwin in Uruguay, 138
Fallot (M.), Magnetic Properties of Alloys of Iron and Iridium, 820; Magnetic Properties of Alloys of Iron and Rhodium, 905; [R. Hocart and], Identification of Various Phases by Magnetic Study and by the X-Rays in Alloys of Iron and Palladium, 81
Fantham (Prof. H. B.), [death], 839; [obituary article], 1001
Farineau (Dr. J.), *L*-Emission Bands of Zinc, Copper, Nickel and Cobalt, 508
Faris (Prof. E.), The Nature of Human Nature: and other Essays in Social Psychology (*Review*), 566
Farquharson (J. S.), Haboobs and Instability in the Sudan, 687
Farrington (A.), [K. Jessen and], Bogs at Ballybetagh, with Remarks on the Development of Late-Glacial Deposits in Ireland, 376
Fauteux (A.), awarded the Tyrrell medal of the Royal Society of Canada, 287
Fawcett (Prof. C. B.), Changing Distribution of Population, 411
Fawcett (Prof. H. S.), Citrus Diseases and their Control. Second edition (*Review*), 526
Fawcett (W.), and Dr. A. B. Rendle, Flora of Jamaica. Vol. 7. Late S. Le Marchant Moore and Dr. A. B. Rendle (*Review*), 302
Federoff (B.), [Mme. Nathalie Demassieux and], Dehydration of the Double Sulphate of Copper and Potassium, 778
Feldenkrais (M.), [M. Pauthenier, L. Vigneron and], The Electrostatic Valve, 518
Felix (Dr. A.), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
Fenner (C. N.), Magmatic Differentiation, 327
Ferguson (W. B.), [death], 716; [obituary article], 797
Fermi (Prof. E.), Lord Rutherford, 1052
Ferraro (V. C. A.), Functions of Quaternions, 1111
Ferris (Prof. G. F.), *Atlas of the Scale Insects of North America* (*Review*), 632
Ffrench (Lt.-Gen. E. G.), [death], 226
Field (Miss M. J.), Religion and Medicine of Gâ People (*Review*), 869
Field (Prof. R. M.), elected a foreign correspondent of the Geological Society of London, 883; work of, 884
Fieser (Prof. L. F.), The Chemistry of Natural Products Related to Phenanthrene. Second edition (*Review*), 704
Finch (Prof. G. I.), Electron Diffraction and Surface Structure (Bedson Lecture), 800
Findlay (Prof. A.), Use of the Name 'Racemic Acid', 22; Chemistry for Everyman (*Review*), 300; A Hundred Years of Chemistry (*Review*), 624
Finkelstein (J.), [J. K. Cline, R. R. Williams and], Synthesis of Vitamin B_1, 856
Fischer, Deitz and Jübermann, Separation of the Rare Earths, 74
Fischer (Prof. H.), awarded the Davy medal of the Royal Society, 840; presented with the Davy medal of the Royal Society; work of, 980
Fischer (W. H.), [Dr. K. Miescher, E. Tschopp and], The Effect of Enol-Esters of Testosterone, 726
Fisher (Prof. Allan G. B.), appointed Price professor of international economics at Chatham House; work of, 143; 842
Fisher (Dr. R. C.), Research on Wood-Destroying Insects, 368
Fitzgerald (M. E. H.), [Prof. E. C. Dodds, W. Lawson and], Œstrogenic Activity of Some Hydrocarbon Derivatives of Ethylene, 772
Fitzgibbon (G.), [Prof. S. M. Dixon, Dr. M. A. Hogan and], Hydrography of the River Severn, 73
Flaum-Fehér (G.), [L. Pollak and], Distribution of Sugar in the Body, and the Action of Insulin, 821
Fleming (Sir Ambrose), Guglielmo Marconi and the Development of Radio Communication, 963
Fletcher (Dr. H. Morley), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
Flett (Sir John Smith), The First Hundred Years of the Geological Survey of Great Britain (*Review*), 915
Fleure (Prof. H. J.), Racial Evolution and Archæology (Huxley Memorial Lecture), 945, 981
Flexner (Dr. S.), elected a supernumerary fellow of Balliol College, Oxford, 694
Florence (Prof. P. S.), Economic Research and Industrial Policy, 411
Flower (W. D.), Temperature and Relative Humidity in the Atmosphere over Lower Egypt, 813
Fock (V.), The Neutrino Theory of Light, 113
Folley (Dr. S. J.), and Dr. P. White, Response of the Pigeon Crop Gland to Prolactin: Inhibition by Œstradiol Monobenzoate, 505
Forbes (A. C.), Some Climatic Theories in Connexion with Tree Remains in and under Peat, 81
Forbes (G.), appointed lecturer in forensic medicine in Sheffield University, 207
Ford (E.), The Nation's Sea-Fish Supply: being the Buckland Lectures for 1936 (*Review*), 952
Forde (Prof. C. Daryll), A Compilation of Migrations (*Review*), 89
Forster (Sir Martin), Chemical Changes and Chances Streatfeild memorial lecture), 1055
Fosdick (R.), work of the Rockefeller Foundation during 1936, 500
Foulkes (Major-Gen. C. H.), Offence and Defence in Gas Warfare (*Review*), 3
Fourie (P. J.), and Dr. C. Rimington, Living Animal Cases of Congenital Porphyrinuria, 68
Fowler (Prof. R. H.), Statistical Mechanics: the Theory of the Properties of Matter in Equilibrium. Second edition (*Review*), 382
Fox (D. L.), Carotenoids and other Liquid-Soluble Pigments in the Sea and in Deep Marine Mud, 519
Fox (F. W.), and W. Stone, Specificity of Indophenol in the Estimation of Ascorbic Acid in Fermented Products, 234
Fox (Dr. J. J.), and Dr. A. E. Martin, Infra-Red Absorption of Hydroxy Compounds near 3μ, 937
Fox (M.), [Prof. H. C. Urey, J. R. Huffman, H. G. Thode and], Concentration of Nitrogen Isotope, 512
Fox (T. R. C.), appointed a demonstrator in engineering in Cambridge University, 476
Fox-Wilson (G.), Insect and Allied Pests of Fruits (*Review*), 215
Frame (J. W.), resignation from Sheffield University, 735
Frame (W. M.), New Type of Threaded Connexion for Oil Well Casing, 117
Francis (Dr. A. G.), appointed deputy Government chemist, 844
Frankel (Prof. M.), and R. Maimin, Natural Activation of Papain, 1015
Frankenburger (Dr. W.), Katalytische Umsetzungen in homogenen und enzymatischen Systemen (*Review*), 827
Fraser (Dr. F. C.), [J. R. Norman and], Giant Fishes, Whales and Dolphins (*Review*), 911

Fraser (Miss Lilian), Ecology of Sooty Mould Fungi, 1104
Frazer (Sir James George), Aftermath: a Supplement to the Golden Bough (*Review*), 260
Freak (R. H.), awarded a Salters' Institute fellowship, 274
Fred (E. B.), [P. W. Wilson and], Mechanism of Symbiotic Nitrogen Fixation, 943
Fredenhagen [Bonhoeffer and], Cannizzaro Reaction, 369
French (Dr. J. Weir), Propagation of Optical Contact, 321
French (Prof. S. J.), The Drama of Chemistry: How Man Deals with Atoms (*Review*), 634
Freon (A.), [P. Auger, P. Ehrenfest, jun., Mme. Thérèse Grivet and], Mechanism of the Production of Cosmic Bundles, 292
Fretter (Vera), Digestion in Polyplacophoran Molluscs, 976
Fricke (H.), and M. Demerec, Influence of Wave-length on Genetic Effects of X-Rays, 519
Friedrich (R.), [A. Maillard and], Products formed by the Incomplete Combustion of Light Liquid Hydrocarbons 985
Friend (Dr. G. E.), Place of Vegetables and Fruit in the Well-balanced Diet, 615
Friesen (Prof. H.), Artificial Release of Crossing-over in Meiosis and Mitosis, 362
Frisch (Dr. O. R.), Dr. H. von Halban, jun. and Dr. J. Koch, The Magnetic Field Acting upon Neutrons inside Magnetized Iron, 360; Capture of Slow Neutrons in Light Elements, 895
Fröhlich (Dr. H.), Elektronentheorie der Metalle (*Review*), 953
Frolov (Prof. Y. P.), translated by C. P. Dutt, Pavlov and his School: the Theory of Conditioned Reflexes (*Review*), 700
Frost (Miss Nancy), Newfoundland Amphipoda and Decapod Larvæ, 898
Frost (Winifred E.), [C. F. Humphries and], Chironomid Fauna of the submerged Mosses, River Liffey, 976
Frye (Royal M.), [Prof. N. A. Kent, W. H. Robinson and], Structure of Hα of Hydrogen, 236
Fryer (Dr. A. C.), [obituary article], 674
Fukushima (I.), [Y. Ishida, T. Suetsugu and], Determination of Electronic Charge by the Oil Drop Method, 29
Fulton (F.), awarded the Radcliffe scholarship in pharmacology of Oxford University, 166
Fulton (Prof. J. F.), and Prof. H. Cushing, A Bibliographical Study of the Galvani and the Aldini Writings on Animal Electricity, 840

Gaddum (Prof. J. H.), Conditioned Reflexes and Psychology (*Review*), 700; appointed professor of pharmacology at the College of the Pharmaceutical Society of Great Britain and director of the society's Pharmacological Laboratories; work of, 717
Galpin (N.), Factors Affecting Hatching Weight of Chickens, 1027
Galvani, Bicentenary of, 391; Celebration at Bologna, 836
Gamelin (H.), [P. Riou, G. Delorme and], Distribution of Manganese and Iron in the Conifers of Quebec Province, 1027
Gand (E.), [A. Tian and], Ionic Dissociation of the Alkyl Halides, 293
Gardner (Dr. A. D.), appointed reader in bacteriology in Oxford University and conferment upon, of title of professor, 38
Gardner (Elinor W.), and Dorothea M. A. Bate, The Bone-bearing Beds of Bethlehem: Their Fauna and Industry, 431
Gardner (J. C. M.), Larvæ of Indian Coleoptera, 592
Gardner (Prof. Percy), [death], 142; [obituary article], 267
Garland (Dr. H. G.), appointed clinical lecturer in medicine and honorary demonstrator in medical pathology in Leeds University, 942
Garnett (Miss A.), Insolation and Relief, 776
Garrod (Miss D. A. E.), Flaked Flints from the Bone Beds of Bethlehem, 808
Garrod (Dr. L. P.), appointed reader in bacteriology at St. Bartholomew's Hospital Medical College, 942
Gask (Prof. G. E.), appointed a member of the Medical Research Council, 190
Gatenby (Prof. J. B.), Biological Laboratory Technique: an Introduction to Research in Embryology, Cytology and Histology (*Review*), 1081
Gates (Prof. R. R.), Double Structure of Chromosomes, 1013
Gautheret (R.), New Researches on the Culture of Cambium Tissue, 905; [A. Guilliermond and], Conditions under which Neutral Red produces the Vital Coloration of the Vacuoles, 40
Gaydon (A. G.), and Dr. R. W. B. Pearse, Band Spectrum of Chromium Hydride, CrH, 110
Gayler (Dr. Marie L. V.), Constitution of the Alloys of Silver, Tin and Mercury; Dental Amalgams, 858
Gee (G.), [Prof. A. C. Cuthbertson, Prof. E. K. Rideal and], The Kinetics of Polymerization, 889
Geiringer (Martha), Influence of the Central Nervous System on the Adaptation of the Colour of the Frog (*Hyla arborea* L.), 41
Geller (R. F.), and E. N. Bunting, Lead Borates, 34
George (Dr. W. H.), Keeping Pace with Physics (*Review*), 443
Germer (L. H.), and K. H. Storks, Structure of Langmuir-Blodgett Films of Stearic Acid, 779
Gerö (Dr. L.), [Dr. R. Schmid and], Structure of a New System of CO Bands, 508
Gibb (Sir Alexander), elected an honorary member of the Engineering Institute of Canada, 274; Research in Engineering, 412; Engineering in Transport, 719
Gibb (Prof. A. W.), [death], 97; [obituary article], 611
Gibberd (G. F.), and others, Prontosil in Puerperal Infections, 284
Gibbons (Dr. S. G.), Scottish Copepods, 116; Variations in Copepod Development, 1064
Gibbs (J. Willard), A Commentary on the Scientific Writings of. Vol. I: Thermodynamics; dealing with the Contents of Volume One of the Collected Works. Edited by Prof. F. G. Donnan and Prof. A. Haas. Vol. 2: Theoretical Physics; dealing with the Contents of Volume Two of the Collected Works. Edited by Prof. A. Haas (*Review*), 298
Gibson (Prof. C. S.), Elementary Chemistry and its Presentation (*Review*), 173; Production of Thin Gold Films, 279; Constitution of Aurous Compounds: Gold Mirrors, 583; A Survey of Organic Chemistry (*Review*), 868
Gifford (E. W.), and Prof. A. L. Kroeber, Pomo Culture, 686
Gilbert (Dr. W. M.), [death], 309
Gill (E. W. B.), Effect of a Magnetic Field on the Electrodeless High-frequency Discharge, 1061
Gillam (A. E.), Prof. I. M. Heilbron, Dr. E. Lederer and V. Rosanova, Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils, 233
Gilson (H. C.), The Percy Sladen Expedition to Lake Titicaca, 877; appointed a demonstrator in zoology in Cambridge University, 1026
Ginns (D. W.), awarded the John Winbolt prize of Cambridge University, 291; Tests for Stresses in Engineering Materials, 858
Girard (Dr. A.), A. Ray and G. Richard, Antimicrobial Action of some Aromatic Compounds, 283
Girard (P.), [L. Bull and], Influence of Electric and Magnetic Fields on the Electric Spark in Air at Atmospheric Pressure, 1111
Glassel (S. A.), Porcellanids and Pinnotherids from Tropical North American Waters, 33
Glasspoole (Dr. J.), The Wettest Place in the British Isles, 540
Glick (D.), Choline Esterase Activity of Superior Cervical Ganglia, 426
Glock (W. S.), Climatic Cycles and Tree Growth, 855
Glocker (Prof. R.), Materialprüfung mit Röntgenstrahlen: unter besonderer Berücksichtigung der Röntgenmetallkunde. Zweite Auflage (*Review*), 914
Glücksmann [Tansley, Spear and], Radiation and Cell Division, 686
Glynn (H. E.), [A. L. Bacharach and], Liver Extract and Hæmoglobin in Rats, 896
Goldenweiser (Prof. A.), Anthropology: an Introduction to Primitive Culture (*Review*), 632

Goldschmidt (B.), Fractionation Coefficients of Salts possessing several Hydrates, 477

Goldschmidt (H. J.), [A. J. Bradley, H. Lipson, A. Taylor and], Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays, 543

Goldschmidt (R.), A Remarkable Parallelism, 83

Goldschmidt (Prof. R.), Spontaneous Chromatin Rearrangements in *Drosophila*, 767

Goldstein (L.), [A. Debierne and], New Transformations Produced at Low Temperatures (*frigadreactions*), 656

Good (N. E.), [R. T. Cotton and], Insects and Mites in Stored Grain, 936

Goodenough (W. M.), appointed a member of the Medical Research Council and treasurer of the Council, 21

Goodeve (Dr. C. F.), The Cluster Theory of Imperfect Gases, 424; appointed reader in chemistry at London University College, 942; and F. D. Richardson, Existence of Chlorous Anhydride, 737

Goodway (Dr. N. F.), and T. F. West, Conversion of β-Phellandrene into a Derivative of α-Phellandrene, 934

Goodwin (A. J. H.), and others, Archæology of the Oakhurst Shelter, George, 167; (6), 334; (6 and 7), 656

Goodwin (E. T.), appointed an assistant lecturer in mathematics in Sheffield University, 735

Goodwin (T. H.), [F. J. Llewellyn, E. G. Cox and], Crystalline Structure of Pentaerythritol, 430

Goossens (A. P.), South African species of *Sporobolis* R.Br. with special reference to Leaf Anatomy, 905

Gordon (Dr. J. E.), appointed professor of preventive medicine and epidemiology at Harvard University Medical School, 582

Gordon (Prof. R. M.), awarded the Chalmers medal of the Royal Society of Tropical Medicine and Hygiene; work of, 98

Gordon (Seton), Thirty Years of Nature Photography: a Personal Record of Two Observers (*Review*), 302

Gordon (Prof. W. T.), The Seventeenth International Geological Congress, 789

Gorman (M. J.), A Non-bulbing Derivative of Yellow-fleshed Swedish Turnip, 333

Gormley (P. G.), Zeros of Legendre Functions, 81

Gorski (F.), Polarimetric Titration of the Oxyacids, 167

Goshawk (E. R.), Air-drag and the Equilibrium of Whirling Threads, 194

Gosset (W. S.), [death], 716; [obituary article], 838

Götzinger (G.), Geological Analysis of the Quaternary Deposits in the Traun Valley region above Gmunden, 41

Gough (G. S.), elected a fellow of Trinity College, Cambridge, 735

Gough (Dr. H. J.), and W. Wood, X-Ray Methods in the Investigation of Failure in Service, 1069

Gould (Lt.-Comdr. R. T.), A Book of Marvels (*Review*), 87

Gourlay (Dr. J. S.), *Viscosity* of Binary Mixtures, 157

Graham (A.), Ciliary Currents on Lamellibranch Gills, 687

Granit (Prof. R.), Absorption Curve for Visual Purple and the Electrical Response of the Frog's Eye, 972

Graue (G.), and N. Riehl, Investigation of Porous Structure, 327

Gravier (Prof. C.), [death], 922

Gray (J. L.), The Nation's Intelligence (*Review*), 528

Gray (Dr. J.), Mentality of Fish, 496

Green (Dr. A. L.), Service Area of a Radio-telegraphic Transmitter, 900; and Dr. G. Builder, Control of Wireless Signal Variations, 76; and Dr. O. O. Pulley, Control of Phase Fading in Long-distance Radio Communication, 76

Green (D. E.), Rust-resistant Antirrhinums, 73; A Downy Mildew of Snapdragons, 511; [J. G. Dewan and], A New Oxidation Catalyst, 1097

Greene (Sir Wilfrid Arthur), conferment upon, of an honorary doctorate by Birmingham University, 80

Greenly (Lt.-Col. J. H. M.), appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 680

Greenshields (F.), Cytology of Parthogenetic Reproduction of Hymenoptera Symphyta (1), 124

Greenwood (Dr. T.), Logic and Empiricism (*Review*), 866

Gregory (Prof. F. G.), and O. N. Purvis, Devernalization of Spring Rye by Anærobic Conditions and Revernalization by Low Temperature, 547

Gregory (P. H.), [A. Beaumont and], A Leaf-spot Disease of *Gerbera Jamesoni*, 511

Gregory, Bt. (Sir Richard), Science and Social Service, 1088

Gresswell (R. K.), Rivers, 496

Grey of Fallodon (late Viscount), Memorial to, 1092

Grierson (Sir Herbert), conferment upon, of an honorary doctorate by Edinburgh University, 80

Griffith (Mrs. F. Ll.), [obituary article], 881

Griffiths (Prof. A.), [obituary article], 97

Grinsell (L. V.), The Ancient Burial-Mounds of England (*Review*), 218

Grist (D. H.), An Outline of Malayan Agriculture (*Review*), 7

Grivet (Mme. Thérèse), [P. Auger, P. Ehrenfest, jun., A. Freon and], Mechanism of the Production of Cosmic Bundles, 292

Gromoff (Col. M.), Long Distance Air Record, 143

Grover (Prof. F. W.), Poetry and Astronomy, 146

Groves (Prof. E. W. H.), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166

Grünberg (Prof. A. A.), Metal-Ammonia Ions, 422

Grundström (Dr. B.), Band Spectrum of Thallium Hydride, 365

Grüneberg (Dr. H.), Gene Doublets as Evidence for Adjacent Small Duplications in *Drosophila*, 932

Gucker, jun. (F. T.), and R. H. Munch, Nature of Calomel Vapour, 648

Guillet (Prof. L.), nominated an honorary vice-president of the Iron and Steel Institute, 104

Guilliermond (A.), and R. Gautheret, Conditions under which Neutral Red produces the Vital Coloration of the Vacuoles, 40

Gundel (Dr. W.), Dekane und Dekansternbilder: ein Beitrag zur Geschichte der Sternbilder der Kulturvölker (*Review*), 701

Gunn (Dr. D. L.), J. S. Kennedy and D. P. Pielou, Classification of Taxes and Kineses, 1064

Gunn (Dr. J. A.), elected a supernumerary fellow of Balliol College, Oxford, 694

Gunther (Dr. R. T.), Early Science in Cambridge (*Review*), 130; Early Astronomical Instruments at Oxford, 1089

Gupta (J.), *Hexaco-ordination of Tellurium*, Molybdenum and Tungsten, 685

Gurney (Dr. R.), Larvæ of Decapod Crustacea, 692

Gurney (R. W.), and Prof. N. F. Mott, *Photolysis of Silver* Bromide and the Photographic Latent Image, 1073

Gurwitsch (Prof. A. G.), Mitogenetic Analysis of the Excitation of the Nervous System (*Review*), 565

Haagen-Smit (A. J.), [K. V. Thimann and], Effects of Salts on Emergence from the Cyst in Protozoa, 645

Hackspill (L.), and A. Borocco, Compounds of the Isotope 2 of Hydrogen with the Alkali Metals (Alkaline Deuterides), 82

Hadorn (E.), An Accelerating Effect of Normal "Ring Glands" on Puparium Formation in Lethal Larvæ of *Drosophila melanogaster*, 943

Hahn (L.), and Prof. G. Hevesy, Origin of Yolk Lecithin, 1059

Hahn (Prof. O.), Lord Rutherford, 1051

Haitinger (O. M.), awarded the Fritz Pregl prize of the Vienna Academy of Sciences, 332

v. Halban, jun. (Dr. H.), A Method of obtaining Polarized Neutron Beams, 425; [Dr. O. R. Frisch, Dr. J. Koch and], The Magnetic Field acting upon Neutrons inside Magnetized Iron, 360; Capture of Slow Neutrons in Light Elements, 895

Haldane (Prof. J. B. S.), The Position of Genetics, 428; first Weldon professor of biometry at University College, London, 612

Hale (R. W.), Products formed during the Preparation of Ketene, 1017

Hale (Dr. W. J.), Prosperity Beckons: Dawn of the Alcohol Era (*Review*), 687

Hall (Sir Daniel), Soil Erosion: the Growth of the Desert in Africa and Elsewhere, 886
Hall (K.), [Dr. V. Korenchevsky and], Effects on Ovariectomized Rats of Progesterone alone and in combination with the other Sexual Hormones, 154; Histological Changes produced by Castration and by Sex Hormones with Adrenals of Normal and of Castrated Male Rats, 318
Hall (R. T.), [J. H. Yoe and], Isotopes of Potassium, 34
Hallpike (C. S.), Prof. H. Hartridge and Dr. A. F. Rawdon-Smith, Response of the Ear to a Phase Reversal, 74
Hamilton (J. G.), Rates of Absorption of Radio-sodium in Normal Human Subjects, 944
Hamilton (J. W. O.), foundation of prizes for radio research, 641; 862
Hamilton (W. J.), Embryology of the Ferret, 775
v. Hámos (Dr. L.), The X-Ray Microscope, 30
Hanson (A. J.), awarded a Pilcher memorial prize of the Royal Aeronautical Society, 1094
Hanson (E. A.), [Dr. J. A. A. Ketelaar and], Elementary Cell and Space Group of Ethylchlorophyllide, 196
Harbord (F. W.), Thomas-Gilchrist Basic Process, 1057
Harington (Prof. C. R.), and others, Structure of Protein, 491
Harkins (Prof. W. D.), and R. J. Myers, Viscosity of Monomolecular Films, 465
Harkness (William), centenary of the birth of; work of, 1004
Harland (Dr. S. C.), Homologous Loci in Wild and Cultivated American Cottons, 467
Harris (Prof. H. A.), Richard Watson and the Constitution of Elements, 926
Harris (Dr. L. H.), Vitamins in Theory and Practice. New edition (*Review*), 302; Nicotinic Acid and the Pellagra-preventing Vitamin, 1070
Harrison (E.), appointed professor of agriculture at the Imperial College of Tropical Agriculture, Trinidad, 1009
Harrison (G. O.), retirement from Birmingham University; work of, 1045
Harrison (Dr. H. S.), Ethnological Museums: Methods and Limitations, 57; retirement of; work of, 227
Harrison (Dr. J. V.), elected lecturer and demonstrator in geology in Oxford University, 1026
Harrison (K. P.), awarded a Harold Fry studentship of King's College, Cambridge, 435
Harrison (Reginald), (1837–1905), work of, 310
Harrison (T.), [C. Madge and], Mass-Observation, 843
Hart (C. A.), [Prof. H. J. Collins and], Principles of Road Engineering (*Review*), 441
Hartley (G. S.), appointed to a Warren research fellowship, 232; The Cis-form of Azobenzene, 281
Hartley (Sir Harold), Agricultural products as Raw Materials for Industry (Mather lecture), 221
Hartley (J. J.), Dalradian Rocks of the Sperrin Mountains, 251
Hartree (Dr. E. F.), Congrès du Palais de la Découverte, International meeting in Paris: Biological Chemistry, 714
Hartridge (Prof. H.), [C. S. Hallpike, Dr. A. F. Rawdon-Smith and], Response of the Ear to a Phase Reversal, 74
Hart-Mercer (J.), elected Gwynaeth Pretty student and Nita King scholar in Cambridge University, 476
Harvey (J.), A New Harmonic Analyser, 74
Haugaard (G.), Mechanism of the Glass Electrode, 66
Häuslmayer (W.), Chemical Development of the Markings of Butterflies, 41
Havas (L.), Colchicine, 'Phytocarcinomata' and Plant Hormones, 191
Havinga (E.), and J. de Wael, Monomolecular Films, 160
Hawkes (Prof. C. J.), Engineering Progress in the Navy, 1024
Hawking (Dr. F.), awarded a Medical Research Council research fellowship in tropical medicine, 274
Haworth (Prof. W. N.), awarded, with Prof. P. Karrer, the Nobel prize for chemistry; work of, 882
Hayes (R. C.), Deep-focus Earthquakes in the South-West Pacific, 855
Hazlewood (S. J.), and others, Pyrroles derived from Acetonylacetone, 695
Hazoumé (P.), Blood-brotherhood in Dahomey, 325
Heathcoat (Dr. F.), appointed vice-principal and head of the chemistry department of the Swansea Technical College, 1058
Hecht (S.), Instantaneous Visual Threshold after Light Adaptation, 83
Heilbron (Prof. I. M.), [A. E. Gillam, Dr. E. Lederer, V. Rosanova and], Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils, 233
Heim (Prof. A.), [death], 455; [obituary article], 573, 611
Heiser (Dr. V. G.), awarded the medal for distinguished service of the Pennsylvanian Society of New York, 274
Heitler (Dr. W.), Absorption of the Soft Component of Cosmic Radiation, 235
Helmsing (I. W.), and W. E. China, Hemipterous Insects of the family Peloridiidæ, 326
de Hemptinne (Prof. M.), J. Jungers and Dr. J. Delfosse, Raman Spectra of Deuteroethylenes, 323
Hemsley (F. R. W.), appointed an honorary demonstrator in anatomy in Leeds University, 942
Henderson (Prof. G. G.), A Retrospect of Chemical Science, 145
Henderson (Prof. G. H.), Some New Types of Pleochroic Haloes, 191
Henderson (H. D.), The Displacement of Labour by Machinery, 679
Henderson (J.), elected an honorary member of the Verein deutscher Eisenhüttenleute; work of, 675
Henderson (Prof. J.), [death], 1043
Henderson (J. R.), Fatigue and Air Movement in Rooms, 976
Henne (A. L.), Fluoroform, 593
Hentschel (C. C.), and Dr. W. R. I. Cook, Biology for Medical Students. Second edition (*Review*), 994
Heptner (Prof. V. G.), General Zoogeography (*Review*), 663
Herchenroder (M.), Atmospheric Pressure at Mauritius, 855
Herrmann (Dr. H.), and G. Perlmann, Reaction between Proteins and Metaphosphoric Acid, 807
Herskovits (Dr. M. J.), Woman Marriage in Dahomey, 284
Hertzler (Prof. Joyce O.), The Social Thought of the Ancient Civilizations (*Review*), 914
Hertzog (Genl.), The South African Protectorates, 99
Herzberg (Prof. G.), translated by Prof. J. W. T. Spinks, Atomic Spectra and Atomic Structure (*Review*), 626
Hess (Prof. V. F.), and A. Demmelmair, World-wide Effect in Cosmic Ray Intensity, as observed during a recent Magnetic Storm, 316
Hesse (Prof. R.), Ecological Animal Geography. Prepared by W. C. Allee and K. P. Schmidt (*Review*), 620
Hetherington (A. L.), Chinese Ceramic Glazes (*Review*), 382
Hevesy (Prof. G.), Lord Rutherford, 1049; and E. Lundsgaard, Lecithinæmia following the Administration of Fat, 275; Dr. K. Linderstrøm-Lang and N. Nielsen, Phosphorus Exchange in Yeast, 725; [L. Hahn and], Origin of Yolk Lecithin, 1059
Hewer (H. R.), conferment upon, of the title of reader in zoology by London University, 778
Hewitt (E. R.), Natural Colour Eclipse Photography, 271
Hewitt (J.), New Forms of the Genus *Acontias* Linn., 1028
Hewlett (Prof. R. T.), Dr. Carl Spengler, 797
Hey (Dr. D. H.), and Dr. W. A. Waters, Free Radicals in Solution, 934
Heyrovský (Prof. J.), and Dr. J. Novák, Overvoltage in Light and Heavy Water, 1022
Hickman (V. V.), Embryology of the Crustacean *Anaspides*, 1018
Hicks (Prof. G. Dawes), The Philosophical Bases of Theism (Hibbert lectures) (*Review*), 485
Higgins (Dr. A. L.), conferment upon, of the title of reader in civil engineering by London University, 1110
Higgs (A. J.), and Dr. S. E. Williams, Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions, 603

Hill (Prof. A. V.), National Factors of Physical Fitness (*Review*), 561
Hill (Dr. C.), and Dr. H. A. Clegg, What is Osteopathy? (*Review*), 788
Hill (Prof. W. C. Osman), Longevity of Monkeys, 72; Embryonic Monkeys and Man, 115; Blood-groups of Veddahs, 548
Hillebrand (K.), Evolution of Cosmic Dust Clouds, 125
Hills (N. G.), [J. C. Earl and], Action of Nitrous Acid on Amines, 1105
Hjärre (A.), and H. Berthelsen, Method for fixing Neutral-red in Supra-vital Stained Blood Smears, 155
Hoare (Sir Samuel), elected Chancellor of Reading University, 694; Air Raid Precautions, 1044
Hocart (A. M.), Polynesia Through Many Eyes (*Review*), 1080
Hocart (R.), and M. Fallot, Identification of Various Phases by Magnetic Study and by the X-Rays in Alloys of Iron and Palladium, 81
Hodgkin (A. L.), appointed demonstrator in physiology in Cambridge University, 123
Hodgkin (R. H.), elected provost of Queen's College, Oxford; work of, 676
Hodsman (H. J.), Institution of Gas Engineers: Autumn Research Meeting, 903
Hogan (A. G.), [W. J. Robbins, Mary A. Bartley, L. R. Richardson and], Pyrimidine and Thiazole Intermediates as Substitutes for Vitamin B_1, 779
Hogan (Dr. M. A.), [Prof. S. M. Dixon, G. Fitzgibbon and], Hydrography of the River Severn, 73
Högbom (Prof. I.), *Distribution of Raw Materials*, 801
Hogentogler (C. A.), and others, Engineering Properties of Soil (*Review*), 635
Hole (D. R.), [Prof. R. H. Stoughton and], Photoperiodic After-Effect, 808
Hollaender (A.), and W. D. Claus, Problem of Mitogenetic Radiation, 1007
Holland (J. H.), Overseas Plant Products (*Review*), 914
Holland (Sir Thomas), elected president of the Geographical Association, 582
Hollick (Dr. F. S. J.), appointed a demonstrator in zoology in Cambridge University, 1026
Holmes (Prof. A.), Origin of Lead Ores, 937
Holmes (Dr. E.), The Metabolism of Living Tissues (*Review*), 91
Holmes (Dr. F. T.), Frictionless Torque-free Suspensions, 1105; and Prof. J. W. Beams, Frictional Torque of an Axial Magnetic Suspension, 30
Holmes (H. N.), and R. E. Corbet, Crystalline Vitamin A, 1020
Holtermann (C.), and P. Laffitte, A New Oxide of Lead, 293
Holway (A. H.), and W. J. Crozier, Law of Minimal Discrimination of Intensities (2), 943
Hönigschmid, Atomic Weight of Phosphorus, 856; Atomic Weight of Neodymium, 1104
Hopf (Prof. L.), Materie und Strahlung (Korpuskel und Feld) (*Review*), 386
Hopkins (Sir Frederick Gowland), address at opening of the new Chemistry Laboratories at Birmingham, 121; elected president of the Cambridge Philosophical Society, 888
Hopkins (Prof. R. H.), and B. Krause, Biochemistry applied to Malting and Brewing (*Review*), 705
Hopwood (Dr. A. T.), Prof. Hans Reck, 351
Hora (Sunder Lal), Researches on Indian Fishes, 367
Horder (Lord), Health and a Day (*Review*), 705
Horeau (A.), [M. Delépine and], Catalysis of the Cannizzaro Reaction by Active Nickel and Platinum, 208
Hornblower (G. D.), Marriage of Osiris, 854
Hornell (J.), Canoes of Polynesia, Fiji and Micronesia, 510
Horowitz (N. H.), [A. Tyler and], Action of Certain Substituted Phenols on Marine Eggs in relation to their Dissociation, 779
Hoskins (Prof. L. M.), [death], 716
Hosoi (T.), Movement Within *Paramecium* Fragments, 647
Houpillart (J.), [C. Dufraisse and], Dissociable Organic Oxides, 1027
House (Prof. F. N.), The Development of Sociology (*Review*), 481
Howchin (Rev. W.), [death], 1043
Howe (Hon. C. D.), elected an honorary member of the Engineering Institute of Canada, 274
Hoyle (F.), Capture of Orbital Electrons, 235
Hrabik (O.), Local Transformation of Solid and Hollow Bones of *Molge cristata* Laur, 1074
Hrdlička (Dr. A.), Racial History in the Arctic, 577; 'Minnesota Man', 1103
Hubble (Dr. E.), Red Shifts and the Distribution of the Nebulæ, 649
Hückel (Prof. W.), Lehrbuch der Chemie. Teil 2: Organische Chemie (*Review*), 868
Hudspeth (H. M.), and D. W. Phillips, Coal Measure Rocks. Part 1, 813
von Huene (Prof. F.), elected a foreign correspondent of the Geological Society of London, 883; work of, 884
Huffman (J. R.), [Prof. H. C. Urey, M. Fox, H. G. Thode and], Concentration of Nitrogen Isotope, 512
Hughes (G. K.), and F. Lions, Derivatives of Higher Catechol Ethers, 695
Huizinga (Dr. D. S.), elected president of the fifth International Grassland Congress, 249
Hulubei (H.), Element 87 (Ml), 1111
Humbert (Prof. P.), Pierre Gassendi, 732
Humphries (C. F.), and Winifred E. Frost, Chironomid Fauna of the Submerged Mosses, River Liffey, 976
Hungerford (S. J.), elected an honorary member of the Engineering Institute of Canada, 274
Hunter (H.), awarded the gold medal of the North-East Coast Institution of Engineers and Shipbuilders, 500
Hunter (Dr. J. de Graaff), Development in International Geodesy, 75
Hunter (Dr. L.), and H. O. Chaplin, Evidence of Restricted Rotation about the N—C Bond in 2 : 6-Disubstituted Acetanilides, 896
Hunter (T. G.), [M. Ba Thi, A. W. Nash and], and others, Solvent Dewaxing, 1105
Huntingford (G. W. B.), Boats of Victoria Nyanza, 812
Huntress (E. H.), Daily Chemical Anniversaries as a Teaching Tool, 616
Huntsman (Prof. A. G.), elected president of the Royal Society of Canada, 287
Hurley (F. H.), [A. F. Scott and], Atomic Weight of Carbon, 1068
Hutchinson (Prof. Arthur), [death], 1043; [obituary article], 1087
Hutton (Dr. Charles), Bicentenary of; work of, 269
Hutton (Dr. J. H.), Assam Origins in relation to Oceania, 413; 487
Huxley (Mrs. E.), Soil Erosion in the United States, 687
Huxley (Dr. J.), [H. G. Wells, G. P. Wells and], Science of Life Series. 9 Vols. (*Review*), 484
Huzayyin (Dr. S. A.), Egyptian University Scientific Expedition to South-West Arabia, 513
Hyde (Dr. H. M.), and G. R. F. Nuttall, Air Defence and the Civil Population (*Review*), 661

Ijdo (J. B. H.), Vitamin C in the Potato, 977
Iimori (T.), Electron Diffraction Studies of Oxides formed on Iron, 278
Iitaka (Dr. I.), A New Equilibrium Diagram for the System Fe—C, 462
Ikebe (T.), [H. Nagaoka and], Magnetic Variation during an Explosion of Asamayama, and its Mechanism, 695
Ikeda (K.), Self-Fertilization in Japanese Slugs, 591
Ilse (Dora), New Observations on Responses to Colours in Egg-laying Butterflies, 544
Imai (S.), An Edible Mongolian Fungus, 'pai-mo-ku', 695
Imai (T.), Temperature and the Growth of *Drosophila* and of *Lymnæa*, 1067
Imms (Dr. A. D.), Prof. V. L. Kellogg, 610; Invertebrates of the Faroes, 733
Ingold (Prof. C. K.), appointed director of the Chemistry Laboratories of London University College, 654
Inwards (R.), [death], 611; [obituary article], 715
Iredale (Dr. T.), and A. Maccoll, Thermal Decomposition of Ethylene Bromide, 24

Irving (Dr. J. T.), [D. N. Mullick and], Nutritional Value of Some Indian Diets, 319

Isaac (W. E.), Evolution of a Growth-Inhibiting Emanation from Ripening Peaches and Plums, 1027

Isherwood, Bt. (Sir Joseph), [death], 881

Ishida (Yoshio), Collision of Two Oil Drops and the Stability of a Non-spherical Oil Drop, 70; 158; I. Fukushima and T. Suetsugu, Determination of Electronic Charge by the Oil Drop Method, 29

Ishii (C.), [Dr. Y. Nishini and], A Cosmic Ray Burst at a depth equivalent to 800 m. of Water, 774

Israels (Dr. M. C. G.), appointed a Foulerton research fellow, 1058

Ito (Y.), [T. Minohara and], Ionosphere Observations in Japan during a Solar Eclipse, 814

van Itterbeck (Prof. A.), and P. Mariens, Determination of the Relaxation Time for the Vibrational Energy of Carbon Dioxide, 850

Ivanoff (Mlle. Nina), [V. Auger and], Molybdenum Blues, 293

Ivanoff (S. S.), Lomonosov and Early Science in Russia (*Review*), 784

Jackson (A. A.), [L. G. G. Warne and], Skatole as a Root Forming Substance, 26

Jackson (D. A.), and Dr. H. Kuhn, Nuclear Moments of Aluminium, 110; Intensity Ratios of the Hyperfine Structure Components of the Resonance Lines of Potassium, 276

Jacobi (Prof. H.), [obituary article], 880

Jacobj (Prof. K.), Eightieth birthday of, 641

Jacquet (P.), [L. Capdecomme and], Reflecting Power of Copper, 40

Jacyna (W.), Differences in the Indications of Gas Thermometers, 167; Thermodynamic Scale below 1° K., 863

Jaeger (J. C.), On Bremsstrahlung, 108

Jaffray (J.), Stratified Geissler Discharge in Different Gases at Atmospheric Pressure, 477

Jameson (A. H.), An Introduction to Fluid Mechanics (*Review*), 635

Jausseran (C.), Anomalies of the Dispersion of Light by Colloidal Solutions of Silver, 209

Javet (P.), [G. Tiercy and], Pulsation of Variable Stars of the Cepheid Type, 125

Jeans (Sir James), to preside over the jubilee meeting of the Indian Science Congress Association, 803; Science and Music (*Review*), 947

Jebsen-Marwedel (Dr. H.), Glastechnische Fabrikationsfehler (*Review*), 830

Jeffcott (Dr. H. H.), [death], 15; [obituary article], 183

Jeffreys (Dr. H.), Reliability of Pacific Seismological Stations, 237

Jena (Prof. L. S.), Indiana. I: Leben, Glaube und Sprache der Quiché von Guatemala; II: Mythen in der Muttersprache der Pipil von Izalco in El Salvador (*Review*), 788

Jenkins (Prof. G. L.), and Prof. A. G. Du Maz, Quantitative Pharmaceutical Chemistry: containing Theory and Practice of Quantitative Analysis applied to Pharmacy. Second edition (*Review*), 634

Jenkins (J.), resignation from Sheffield University, 735

Jenkins (Rhys), The Collected Papers of (*Review*), 301

Jenkins (R. B. M.), appointed assistant lecturer in civil engineering in Sheffield University, 904

Jenkins (R. O.), [Dr. M. Benjamin and], Surface Migration of Barium, 152

Jenks (Prof. A. E.), "Minnesota Man", 578; Pleistocene Man in Minnesota: a Fossil *Homo sapiens*. With a chapter on the Pleistocene Geology of the Prairie Lake Region, by Dr. G. A. Thiel, 596

Jensen (Prof. B.), translated and revised by G. S. Avery, jun., and P. R. Burkholder, with the collaboration of Harriet B. Creighton and Beatrice A. Scheer, Growth Hormones in Plants (*Review*), 257

Jentschke (W.), and G. Stetter, Short-range Particles emitted when Polonium α-Particles are scattered by Heavy Nuclei, 821

Jenyns (R. S.), Early Chinese Bronzes, 591

Jessen (K.), and A. Farrington, Bogs at Ballybetagh, with remarks on the development of Late-Glacial Deposits in Ireland, 376

Joerg (W. L. G.), and O. M. Millar, Map of Ellsworth Trans-Antarctic Flight, 648

Johnson (Prof. T. B.), A New Purine in Tea, 814

Johnston (J. E.), [Dr. H. W. B. Skinner and], *M*-emission Bands of Zinc, Copper and Nickel, 508; Absorption Edges in the Soft X-Ray Region, 732

Johnstone (Prof. R. J.), Some Thoughts on Medical Education, 186

Jones (Prof. Bradley), Elements of Practical Aerodynamics (*Review*), 175

Jones (C. D. P.), appointed a demonstrator in anatomy in Cambridge University, 123

Jones (Prof. F. Wood), appointed professor of anatomy in Manchester University; work of, 15

Jones (G. Howard), The Earth Goddess: a Study of Native Farming on the West African Coast (*Review*), 698

Jones (Rev. N.), [A. L. Armstrong, H. B. Maufe and], Antiquity of Man in Rhodesia, 469

de Jong (W. F.), Two Spectrometers for X-Ray Analysis, 768

Jongmans (Dr. W. J.), elected a foreign fellow of the Geological Society of London; work of, 883

Jordan (Prof. H. E.), and Prof. J. E. Kindred, A Textbook of Embryology. Third edition (*Review*), 949

Jordan (Dr. K.), Lord Rothschild, 574

Jörgensen (A.), Practical Management of Pure Yeast: the Application and Examination of Brewery, Distillery and Wine Yeasts. Third edition, revised by A. Hansen (*Review*), 705

Joyet-Lavergne (P.), Distinguishing the Zones of Oxidation in the Living Cell by the Method of Cobalt Salts, 125

Jübermann (Fischer, Dietz and], Separation of the Rare Earths, 74

Judge (A. W.), Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance. Third edition (*Review*), 704; Car Maintenance and Repair. Second edition (*Review*), 704

Juilfs (J.), Ionization by Radioactive Gamma and Cosmic Rays in Different Gases, 767

Julia (Prof. G.), Introduction mathématique aux théories quantiques: Éléments de géométrie infinitésimale (*Review*), 950; rédigés par Dr. G. Bourion, Exercises d'analyse. Tome 4 (*Review*), 445

Jungers (J.), [Prof. M. de Hemptinne, Dr. J. Delfosse and], Raman Spectra of Deuteroethylene, 323

Just (Dr. G.), appointed director of the Institute of Genetics of the Health Office of the Reich at Berlin-Dahlem, 766

Juza (R.), and R. Langheim, Adsorption of Gases and Vapours on Activated Charcoal, 649

Kadam (B. S.), and others, Genetics of Rice, 1068

Kaempffert (W.), Science, Invention and Society, 803

Kalekar (H.), Phosphorylation and Respiration, 1103

Kamal (Prince Youssouf), Hallucinations scientifiques (les portulans) (*Review*), 662

Kania (A.), Magnetic Declination at Cracow during the Period 1914–36, 335

Kapitza (Dr. P.), Lord Rutherford, 1053

Kaposi (Prof. Moriz), centenary of the birth of; work of, 717

Karrer (Prof. P.), awarded, with Prof. W. N. Haworth, the Nobel prize for chemistry; work of, 882

Kasner (E.), Trihornometry: a New Chapter of Conformal Geometry, 519

Kasterin (N. P.), Aerodynamic and Electrodynamic Equations, 244

Kaufmann (B. P.), and M. Demerec, Frequency of induced Breaks in Chromosomes of *Drosophila melanogaster*, 943

Kavanagh (F.), [W. J. Robbins and], Intermediates of Vitamin B_1, and growth of Phycomyces, 943

Kaye (Dr. G. W. C.), Noise and the Nation, 408; 446; 490

Keane (J.), [J. Breen, T. J. Nolan and], Chemical Constituents of Lichens found *in* Ireland—*Pertusaria concreta*, 333; [Margaret Mohan, T. J. Nolan and], Chemical Constituents of Lichens found in Ireland—*Parmelia conspersa*, Ach., 376

Kearns, Martin and Wilkins, Egg-Killing Washes, 469

Keeble (Sir Frederick), Foundations of Terrestrial Life: The Soil and the Green Plant, 1107

Keen (Dr. B. A.), African Agricultural Problems (*Review*), 698

Keidan (I. J.), appointed an honorary demonstrator in anatomy in Leeds University, 942

Keith (Sir Arthur), Bronze Bust of, 1094

Kellner (Dr. L.), Infra-red Spectrum and Molecular Structure of Diketopiperazine and Tetramethyldiketopiperazine, 193

Kellogg (Prof. V. L.), [death], 309; [obituary article], 610

Kemmer (Dr. N.), Interaction of Nuclear Particles, 192

Kendal (Dr. L. P.), and Dr. L. H. Stickland, The Initial Stages of *Glycolysis in* Muscle Extracts, 360

Kendrick (T. D.), Scandinavian Influence in Northumbrian Art, 1090

Kennaway (Prof. E. L.), awarded the Baly medal of the Royal College of Physicians of London, 232; presented with the Baly medal of the Royal College of Physicians of London, 722

Kennedy (J. M.), appointed lecturer in infectious diseases in Sheffield University, 207

Kennedy (J. S.), Phase Transformation in Locusts in the Field, 889; [Dr. D. L. Gunn, D. P. Pielou and], Classification of Taxes and Kineses, 1064

Kennelly (Dr. A. E.), Giorgi's System of Units, 20

Kent (Duke of), conferment upon, of an honorary doctorate by Birmingham University, 735

Kent (Prof. N. A.), Royal M. Frye and W. H. Robinson, Structure of Hα of Hydrogen, 236

Kenworthy (L.), Methods of Testing Zinc Coatings of Iron and Steel, 858

Kermack (W. O.), and A. G. McKendrick, *Tests for* Random Observations, 369

Ketelaar (Dr. J. A. A.), and E. A. Hanson, Elementary Cell and Space Group of Ethyl-chlorophyllide, 196

Keynes (J. M.), and others, Britain and the Beast (*Review*), 623

Khanna (Mohan Lal), [Prof. S. S. Bhatnagar, Dr. N. Lessheim and], The Ground State of the Se_2 Molecule, 152

Kidson (E.), Cyclone Series in the Caribbean Sea, October 17–24, 1935, 286

Kilpatrick (M.), [K. A. Krieger and], Conductance of Mixtures of Strong Electrolytes, 1020

Kimball (R. F.), Inheritance of Sex at Endomixis in *Paramecium aurelia*, 943

Kimura (K.), [B. Arakatsu, Y. Uemura and], Expulsion of Neutrons from Lead by Cosmic Rays, 277

Kimura (T.), An Improvement on Cyanin Synthesis (mixed solvent process) and the reaction of Orthothioformic Ester, 695

Kindred (Prof. J. E.), [Prof. H. E. Jordan and], A Textbook of Embryology. Third edition (*Review*), 949

King (A. J.), [B. G. Churcher and], Performance of Noise Meters in Terms of the Primary Standard, 331

King (Dr. E. J.), Solubility of Silica Dusts, 320

Kishinouye (F.), Earthquake Swarm of Itô, Japan, 977

Kisser (J.), and K. Lohwag, Histochemical Study of Lignified Cell Walls, 335

Kitson (A.), [death], 611

van Kleef (G.), [J. Clay and], Conductivity of Pure Gases at High Pressures, 1111

Kleinholz (Dr. L. H.), and Dr. J. H. Welsh, Colour Changes in *Hippolyte varians*, 851

Knight (Dr. B. H.), Geology in Engineering (*Review*), 259; Science and the Modern Highway (*Review*), 441

Knowles (F. G. W.), elected to the Naples Biological scholarship of Oxford University, 166

Kobayashi (R.), [J. Obata and], A Direct-reading Pitch Recorder and its applications to Music and Speech, 695

Kobjakova (Z. I.), Decapod Crustacea of Japan, 72

Koch (Dr. J.), [Dr. O. R. Frisch, Dr. H. von Halban, jun., and], The *Magnetic Field acting* upon Neutrons inside Magnetized Iron, 360; Capture of Slow Neutrons in Light Elements, 895

Kögl (Prof. F.), and others, Growth Factors, 161

Kolkmeijer (Dr. N. H.), C. J. Krom and H. Kunst, X-Ray Intensifying Screens adapted to Structure Analysis, 67

Koller (Dr. L. R.), The Physics of Electron Tubes. Second edition (*Review*), 133

Koller, (Dr. P. C.), Human Sex Chromosomes, 429

König (Dr. A.), Die Fernrohre und Entfernungsmesser. Zweite Auflage (*Review*), 831

Konzett (H.), Promotion of Sleep and Narcosis by Dyes, 821

Korenchevsky (Dr. V.), and K. Hall, Effects on Ovariectomized Rats of Progesterone Alone and in Combination with the other Sexual Hormones, 154; Histological Changes Produced by Castration and by Sex Hormones in the Adrenals of Normal and of Castrated Male Rats, 318

de *Körösy (Prof. K.), Transitive* Interference in Gene Linkages, 322

Kothari (Dr. D. S.), and B. N. Srivasava, Joule-Thomson Effect and Quantum Statistics, 970

Kraft (J.), [A. Chrétien and], Uranyl Phosphites, 251

Kramer (M. M.), [C. H. Whitnah, B. L. Kunerth and], Determination of Lactoflavin in Milk, 430

Krause (B.), [Prof. R. H. Hopkins and], Biochemistry Applied to Malting and Brewing (*Review*), 705

Kremann (Prof. R.); Mitbearbeitet von Dr. M. Pestemer, Zusammenhänge zwischen physikalischen Eigenschaften und chemischer Konstitution (*Review*), 831

Krieger (K. A.), and M. Kilpatrick, Conductance of Mixtures of Strong Electrolytes, 1021

Krishnan (Prof. K. S.), and A. Mookherji, Magnetic Anisotropy of Rare Earth Sulphates and the Asymmetry of their Crystalline Fields, 549; Crystal Structure and the Magnetic Anisotropy of $CuSO_4 \cdot 5H_2O$, 896

Kritzmann (M. G.), [Prof. A. E. Braunstein and], Formation and Breakdown of Amino-acids by Intermolecular Transfer of the Amino Group, 503

Kroeber (Prof. A. L.), [E. W. Gifford and], Pomo Culture, 686

Krom (C. J.), [Dr. N. H. Kolkmeijer, H. Kunst and], X-Ray Intensifying Screens Adapted to Structure Analysis, 67

Krug (Dr. C. A.), Chromosomes of Coffee Plants, 429

Krzemieniewska (Mme. H.), and S. Krzemieniewski, The Myxobacteria-Cellulose-Degrading Agents, 167

Krzemieniewski (S.), [Mme. H. Krzemieniewska and], The Myxobacteria-Cellulose-Degrading Agents, 167

Kuczynski (Dr. R. R.), Registration and Population Trends, 966

Kuenen (P. H.), Formation of Submarine Canyons, 117

Kuhlmann (Prof. A. G.), The Individuality of Gliadin, 119

Kuhn (Dr. H.), [D. A. Jackson and], Nuclear Moments of Aluminium, 110; Intensity Ratios of the Hyperfine Structure Components of the Resonance Lines of Potassium, 276

Kuhn (Prof. R.), and P. Desnuelle, Protein of Yellow Enzyme, 936

Kuhn (Dr. W.), appointed professor of physical chemistry in Kiel University, 358

Kunasheva (C. G.), [Prof. W. I. Vernadsky, B. K. Brunowsky and], Concentration of Mesothorium-I by Duckweed (*Lemna*), 317

Kunerth (B. L.), [C. H. Whitnah, M. M. Kramer and], Determination of Lactoflavin in Milk, 430

Kunst (H.), [Dr. N. H. Kolkmeijer, C. J. Krom and], X-Ray Intensifying Screens Adapted to Structural Analysis, 67

Kunz (Prof. J.), and R. G. La Baw, Optical Rotatory Power of Turbid Solutions in an Electric Field, 194

Kynch (G. J.), [Dr. W. G. Penney and], Absorption Spectra Evidence of the Decomposition of the Ground Term of Nd+++ Ion Due to Crystalline Fields, 109

La Baw (R. G.), [Prof. J. Kunz and], Optical Rotatory Power of Turbid Solutions in an Electric Field, 194
Lachman (Dr. G. V.), awarded the Wakefield gold medal of the Royal Aeronautical Society, 1094
Lacroix (A.), Reality of an Eruption of the Soufrière of Saint-Vincent in 1718, 656
Lada (Dr. P.), [obituary], 1087
Laffitte (P.), [C. Holtermann and], A New Oxide of Lead, 293 ; [J. Baron and], Inflammation of Acetaldehyde, 477
Laidler (P. W.), Pipes and Smoking in South Africa, 656
Laissus (J.), Cementation of Nickel by Beryllium, 251
Lambert (Dr. R. H.), [Dr. S. E. Sheppard, R. D. Walker and], Mechanism of Optical Sensitizing of Silver Halides by Dyes, 1096
Landau (Prof. E.), Übereinige neuere Fortschritte der additiven Zahlentheorie (*Review*), 950
Landau (Dr. L.), and G. Rumer, Production of Showers by Heavy Particles, 682
Langdon (Prof. S. H.), [obituary article], 14
Langheim (R.), [R. Juza and], Adsorption of Gases and Vapours on Activated Charcoal, 649
Langley (Miss E. A.), appointed by the Board of Education inspector of meals for school children, 641
Langmuir (Dr. I.), Chemical Research, 901 ; [K. B. Blodgett and], Built-up Molecular Films, 470
Lapage (Dr. G.), Nematodes Parasitic in Animals (*Review*), 526
Larsen (Dr. K.), Invertebrates of Dybsø Fjörd, 1018
Larsen (M. J.), [D. Lewis and], Cancellation, Reinforcement and Measurement of Subjective Tones, 779
Lauppe (W.), [Dr. G. Briegleb and], Raman Spectra of Oxonium Compounds, 236
Laurie (A. H.), Age and Stock of Blue Whales, 201
Laustsen (Winge and), Diploid and Haploid Colonies of a Yeast, 1104
Law (Dr. R. R.), [Dr. V. K. Zworykin, W. H. Painter and], Projection Television, 286
Lawrence (Prof. E. O.), awarded the Hughes medal of the Royal Society, 840 ; presented with the Hughes medal of the Royal Society ; work of, 981
Lawrence (R. F.), Odoriferous Glands of South African Harvest Spiders, 209
Lawson (W.), [Prof. E. C. Dodds, M. E. H. Fitzgerald and], Œstrogenic Activity of Some Hydrocarbon Derivatives of Ethylene, 772
Lea (Dr. F. C.), Hardness of Metals (*Review*), 260
Lea (Dr. F. M.), Hydraulic Cements, 899
Leach (E. H.), appointed William Hulme lecturer in physiology at Brasenose College, Oxford, 166
Leacock (Prof. S.), awarded the Lorne Pierce medal of the Royal Society of Canada, 287
Le Bras (J.), [C. Dufraisse and], Combustible Substances, *Regarded as Helping Incombustible Extinguishers*, for the Practical Extinction of Flames, 905
Leclainche (Prof. E.), seventy-fifth birthday of, 21
Lecoq (R.), Influence of Iodine and of Some Inorganic and Organic Iodine Compounds on the Bone Lesions of Experimental Rickets, 334
Lederer (Dr. E.), [A. E. Gillam, Prof. I. M. Heilbron, V. Rosanova and], Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils, 233
Lee, (Dr. A. W.), Baffin's Bay Earthquake of 1933, 369
Lee (Sir George), elected president of the Institution of Electrical Engineers, 104 ; Co-operation between the Engineering Professions, 799
Leggett (D. M. A.), elected a fellow of Trinity College, Cambridge, 735
Lehmann (Prof. A. L. F.), [death], 576 ; [obituary article], 960
Lehmann (H.), [Dr. J. Needham and], Glyceraldehyde and Embryonic Glucolysis, 198
Leighton (P. A.), [P. C. Cross, J. Burnham and], Structure of Water, 512
Leitch (J. D.), and L. B. Leppard, Dust Control in Industry, 772
Lejay (P.), General Characters of the Acceleration of Gravity in the Levant, 694 ; Absorption of Solar Radiation by the Atmosphere in Band *A*, 943
Lemaître (Prof. G.), Longitude Effect and the Asymmetry of Cosmic Radiation, 23
Lemberg (Dr. R.), B. Cortis-Jones and M. Norrie, An Oxyporphyrin Hæmatin Compound as Intermediate between Protohæmatin and Verdohæmatin, 65
Lemoigne (M.), P. Monguillon and R. Desveaux, Reduction of Nitric Acid to Hydroxylamine by the Higher Plants, 293
Leppard (L. B.), [J. D. Leitch and], Dust Control in Industry, 772
Lescher (T. E.), Pharmacy To-day—Its Responsibilities, 228
Lessheim (Dr. H.), [Prof. S. S. Bhatnagar, Mohan Lal Khanna and], The Ground State of the Se_2 Molecule, 152
Leverhulme (Lord), Necessities of Scientific Training, 144
Levi (Dr. F.), Diffraction of Light by Ultrasonics at Oblique Incidence, 969
Levi-Civita (Prof. T.), Double Stars and Relativity, 470
Levi-Strauss (C.), Clan Reciprocity among the Bororo, 429
Levine (Dr. I.), Faithful Rebels : A Study in Jewish Speculative Thought (*Review*), 218
Levy (Prof. H.), Application of Scientific Methods to Problems involving Social Relationships, 1055
Levyns (M. R.), Geographical Distribution of Plants in the Western Portion of the Little Karroo, 657
Lewis (A. D.), Roaring Sands of the Kalahari Desert, 285 ; Fulgurites from Witsands, Kalahari, 368
Lewis (D.), and M. J. Larsen, Cancellation, Reinforcement and Measurement of Subjective Tones, 779
Lewis (Prof. D. M.), [death], 226 ; [obituary article], 392
Lewis (Miss L. F.), Secular Trends of Temperature, 899
Lewis (M. M.), Infant Speech : a Study of the Beginnings of Language (*Review*), 172
Lewis (T.), and E. E. Pochin, Pain Nerves, 325
Lexer (Prof. E.), awarded the Goethe medal for art and science, 148
Liebmann (H.), [Prof. J. A. Crowther and], An Effect of X-Radiation on the ζ Potential of Colloidal Graphite, 28
Liepmann (H.), translated by Eden and Cedar Paul, Death from the Skies : a Story of Gas and Microbial Warfare (*Review*), 176
Lignell (A.), Practical Difficulties in International Telephony, 312
Linderstrøm-Lang (Dr. K.), Principle of the Cartesian Diver applied to Gasometric Technique, 108 ; [Prof. G. Hevesy, N. Nielsen and], Phosphorus Exchange in Yeast, 725
Lindsay (Sir Harry), Interrelation between Science, Agriculture and Industry, 652
Link (Prof. G. K. K.), Role of Heteroauxones in Legume Nodule Formation, Beneficial Host Effects of Nodules, and Soil Fertility, 507
Linnett (J. W.), [Dr. H. W. Thompson and], Force Constants and Molecular Structure, 1065
Lions (F.), [K. J. Baldick and], Derivatives of 6 : 7-Dimethoxybenzoparathiazine, 695 ; [G. K. Hughes and], Derivatives of Higher Catechol Ethers, 695
Lipmann (F.), Pyruvic Acid Dehydrogenation, Vitamin B_1 and Cocarboxylase, 25 ; A Coloured Intermediate on Reduction of Vitamin B_1, 849
Lips (Prof. J. E.), translated by V. Benson, The Savage Hits Back : or The White Man through Native Eyes (*Review*), 619
Lipschütz (Prof. A.), Androgenic Endocrine Activity in the Female Mammal, 892
Lipson (H.), [A. J. Bradley, H. J. Goldschmidt, A. Taylor and], Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays, 543 ; [Dr. A. J. Bradley and], Rapid Survey of Ternary Alloy Systems by X-Rays, 1069
Lissimore (N.), appointed honorary demonstrator in pathology in Leeds University, 942
Ljungström (O.), Philosophical Overhaul, 615

Llewellyn (F. J.), E. G. Cox and T. H. Goodwin, Crystalline Structure of Pentaerythritol, 430
Lloyd (Ll. S.), Music and Sound (*Review*), 947
Locher (G. L.), [Mary Nagai and], Production of Mutations by Neutrons, 111
Lockhart (Dr. L. P.), Wider Issues of Health Legislation in Industry, 1090
Lodge (Prof. Alfred), [death], 1002
Loewe (Dr. F.), Meteorological Connexions between Greenland and Europe, 593
Loewenthal (Dr. H.), [Dr. J. B. Bateman, Dr. H. Rosenberg and], Alleged Specific Effects of High-frequency Fields on Biological Substances, 1063
Lohwag (K.), [J. Kisser and], Histochemical Study of Lignified Cell Walls, 335
London (F.), A New Conception of Supraconductivity, 793; 834
Longsworth (L. G.), Densities of Mixtures of Light and Heavy Water, 900
Loofbourow (Prof. J. R.), [G. S. Sperti, Sister Cecilia Marie Dwyer and], Proliferation-Promoting Substances from Cells Injured by Ultra-Violet Radiation, 643
Loomis (Prof. F. B.), [death], 393
Lord (Dr. R. C.), and Dr. A. Wright, Structure of Carbon Suboxide, 856
Lorimer (J. H.), bequest to the Edinburgh Astronomical Association, 886
Louderback (G. D.), Fault-Movements and the Safety of Reservoir Dams, 160
Love (Prof. A. E. H.), awarded the Sylvester medal of the Royal Society, 840; presented with the Sylvester medal of the Royal Society; work of, 980
Lovern (Dr. J. A.), Dr. J. R. Edisbury and Dr. R. A. Morton, A New Source of Vitamin A, 276
Lowery (Dr. H.), appointed principal of the South-West Essex Technical College, 803
Lowndes (A. G.), The Term "Gnathobase Lankester", 33; Body Orientation in Crustacea, 241
Lowry (late Prof. T. M.), and A. C. Cavell, Intermediate Chemistry (*Review*), 910
Lub (Mlle. Willy A.), Optical Spectrum of Actinium, 40
Ludlam (Dr. E. B.), A. W. Pryde and H. Gordon Rule, Optical Rotatory Power of Turbid Solutions in an Electric Field, 194
Ludovici (A. M.), The Future of Woman (*Review*), 486
Lundsgaard (E.), [Prof. G. Hevesy and], Lecithinæmia following the Administration of Fat 275
Lunz (G. R.), Stomatopoda of the Bingham Oceanographic Collection, 551
Lustig (Senator A.), [death], 576
Lutenberg (A.), [Prof. M. Ushakov and], Oxidation of Cholesterol and Dehydroandrosterone by Means of Osmic Acid, 466
Lyall (R. A.), awarded the scholarship of the North-East Coast Institution of Engineers and Shipbuilders, 500
Lynch (Father J.), Effect of Occluded Hydrogen on the Rigidity of Metals, 363
Lythgoe (Dr. R. J.), Structure of the Retina and the Role of its Visual Purple (Thomas Young oration), 1045
Lyttelton (Dame Edith), Some Cases of Prediction: a Study (*Review*), 1078
Lyttleton (Dr. R. A.), appointed a faculty assistant lecturer in mathematics in Cambridge University, 476

Maby (C.), Sunspot Photography with a Small Visual Refractor, 552
Macara (T.), Science and the Conservation of Food, 203
Macarthur (Anne R.), Training in Domestic Science, 421
MacBride (Prof. E. W.), Miss Dorothy Sladden, 184; Mendel, Morgan and Genetics, 348; Cytology of *Lepidosiren*, 932
McCallien (W. J.), Structure of the Rathmullen District, Co. Donegal, 167
McCarrison (Sir Robert), Nutritional Requirements of Pregnancy, 186
Macht (Dr. D. I.), Absorption of Tri-brom Ethanol through the Skin, 849
McClean (Capt. W. N.), River Flow Records. Series A: River Garry. Sheet No. 1; Sheet B: River Moriston. Sheet No. 1. Series C: River Ness. Sheets 1–14 (*Review*), 872
McCleary (Dr. G. F.), The Menace of British Depopulation (*Review*), 528
Maccoll (A.), [Dr. T. Iredale and], Thermal Decomposition of Ethylene Bromide, 24
McDermott (L. H.), Daylight Illumination Necessary for Clerical Work, 201
MacDonald (J. Ramsay), Science and the Community (Radford Mather Lecture), 756; [obituary article], 839
MacDonald (Malcolm), The South African Protectorates, 99
McDougall (Prof. W.), *Journal of Parapsychology*, 272
MacDowell (Dr. E. C.), Inheritance of Leukæmia in Mice, 368
Macfarlane (Miss Eileen W. E.), Eastern Himalayan Blood-Groups, 591
McGowan (Lord), Commercial Production of Oil from Coal, 143
McGregor (A. G.), The Economic Reforms required for Lasting Prosperity and Peace, 354
Mache (H.), and O. Moszkowicz, Ionization of Air at Low Pressures by γ-Rays, 1074
McIlroy (Dame Louise), Nutritional Requirements of Pregnancy, 186
McKendrick (A. G.), [W. O. Kermack and], Tests for Random Observations, 369
Mackenzie (Sir Morell), centenary of the birth of; work of, 16
MacKichan (I. W.), awarded a Medical Research Council junior research fellowship in tropical medicine, 274
McKie (Dr. D.), [Prof. J. R. Partington and], Levity of Phlogiston, 1089
McKinney (Dr. H. H.), Mutation in Tobacco Virus, 33
Mackintosh (Sir Ashley), [death], 716
Maclachlan (Dr. W. G.), Problem of Chemotherapy in Pneumonia, 901
McLaughlin (D. B.), Spectrum of Nova Herculis, 593
Maclean (Prof. M.), [death], 455; [obituary article], 673,
MacMichael (Sir Harold A.), appointed High Commissioner and Commander-in-Chief for Palestine and Commissioner for Transjordania; work of, 1003
Macnair (Dr. D. S.), [death], 1002
MacNalty (Sir Arthur), Public Health in Great Britain, 927
McVittie (Dr. G. C.), Hyperbolic Space, 773; Hyperbolic or Spherical Space, 1105
Madelung (Prof. E.), unter mitarbeit von Dr. K. Boehle und Dr. S. Flügge, Die mathematischen Hilfsmittel des Physikers. Dritte Auflage (*Review*), 218
Madge (C.), Mass-Observation, 229; and T. Harrison, 843
Madigan (Dr. C. T.), Natural History and Science in South Australia, 419; Discovery of a Meteoric Crater and a Meteorite in Australia, 801
Madsen (Dr. T.), re-elected president of the Health Committee of the League of Nations, 315
Magat (M.), [H. Moureu, G. Wétroff and], Raman Spectra of the Two Forms of Phosphorus Pentachloride, 598; Stereochemical Structure of Phosphorus Pentachloride, 863
Maillard (A.), and R. Friedrich, Products formed by the Incomplete Combustion of Light Liquid Hydrocarbons, 985
Maillet (L.), Emission of X-Rays by Vacuum Tubes of Very Small Dimensions, Submitted to a High-frequency Current, 557
Maimin (R.), [Prof. M. Frankel and], Natural Activation of Papain, 1015
Maitra (A. T.), [Prof. K. Prosad and], Intensity and Structure Changes of the *Lα* Emission Lines of Cu and Fe on Intense Cooling of their Anticathodes, 464
Makinson (R. E. B.), awarded a Strathcona exhibition for physics at St. John's College, Cambridge, 476
Malan (Dr. A. I.), [Dr. P. J. Du Toit and], Phosphorus and Calcium Deficiency Diseases as Two Etiologically Distinct Entities, 153

Malcolm (Dr. L. W. G.), appointed curator of the Horniman Museum, 228
Malinowski (Prof. B.), The Dilemma of Contemporary Linguistics (*Review*), 172
Maman (A.), The Octanes, 656
Manlove (C. W.), Coloured Roads, 1091
Mann (Dr. F. G.), and Dr. A. F. Wells, Phosphine and Arsine Derivatives of the Group I (*b*) Metals: Volatile Derivatives of Gold, 502
Mann (Dr.), Arctic and Antarctic Diatom Floras, 1019
Mannheim (Prof. K.), Ideology and Utopia: an Introduction to the Sociology of Knowledge (*Review*), 481
Marais (E. N.), with a biographical note by his son, and translated by Winifred de Kok, The Soul of the White Ant (*Review*), 622
Marconi (Marchese), [death], 142; [obituary article], 182
Marett (Dr. R. R.), conferment upon, of an honorary doctorate by Oxford University; work of, 923
Mariëns (P.), [Prof. A. van Itterbeck and], Determination of the Relaxation Time for the Vibrational Energy of Carbon Dioxide, 850
Mark (Prof. H.), The Synthesis of Large Molecules, 8
Marr (J. W. S.), Antarctic Surveys: Work of the *Discovery* Investigations, 863
Marshak (A.), Effect of X-Rays on Chromosomes in Mitosis, 779
Marshall (Dr. F. H. A.), Sexual Periodicity, 284; Human Embryology (*Review*), 949
Marshall (Dr. P. G.), *Para*-Cresol from the Urine of Pregnant Mares, 362
Martin [Fajans and], Protective Spray Deposits, 511; [Kearns, Wilkins and], Egg-killing Washes, 469
Martin (Dr. A. E.), [Dr. J. J. Fox and], Infra-red Absorption of Hydroxy Compounds near 3μ, 937
Martin (Dr. H.), The Scientific Principles of Plant Protection: with Special Reference to Chemical Control (*Review*), 384
Martin (H. E. L.), awarded the M. C. James medal of the North-East Coast Institution of Engineers and Shipbuilders, 500
Martin (P.), awarded the Denny marine engineering scholarship of the Institution of Naval Architects, 722
Martyn (Dr. D. F.), and G. H. Munro; A. J. Higgs and Dr. S. E. Williams, Ionospheric Disturbances, Fade-outs, and Bright Hydrogen Solar Eruptions, 603
Martynov (A.), Fossil Insects from Kansas Rocks, 116
Masaryk (Prof. T. G.), [obituary article], 575
Maseré (M.) and R. Paris, Constitution of Scoparoside (Scoparine) of *Sarothamnus scoparius*, 125
Masiyama (Dr. Y.), Magnetostriction, 552
Mason (Dr. T. G.), [Dr. E. Phillis and], Concentration of Solutes in Vacuolar and Cytoplasmic Saps, 370
Massee (Dr. A. M.), The Pests of Fruits and Hops (*Review*), 215
Massey (H. S. W.), Creation of Electron Pairs by Nuclear Capture of Neutrons, 292
Masson (Sir David Orme), [death], 268; [obituary article], 534
Masson (Prof. Irvine), *Iodine*, 1005
Mather (G. Radford), founder of the Radford Mather Lecture; work of, 762
Mather (Prof. T.), [death], 15; [obituary article], 96; 226
Mather (Prof. W. T.), [death], 184
Matherson (C.), Fisheries of Wales, 721
Matsumoto (N.), Oriented Crystallization, 978
Matthew (late Dr. W. D.), Paleocene Faunas of the San Juan Basin, New Mexico (*Review*), 46
Maufe (H. B.), [A. L. Armstrong, Rev. N. Jones and], Antiquity of Man in Rhodesia, 469
Maurice (Major-Genl. Sir Frederick), Haldane, 1856–1915: The Life of Viscount Haldane of Cloan, K.T., O.M. (*Review*), 989
Maurice (H. G.), awarded the Johannes Schmidt medal, 104
Maxwell, Bt. (Sir Herbert), [death], 797; [obituary article], 959
Mayer (A.), Encyclopédie française. Tome 4: La vie (*Review*), 664
Mayor (Dr. J.), *Lag of Social Sciences*, 1021
Mayne (J. E. O.), Effect of Fibre Cores on Internal Corrosion in Colliery Winding Ropes, 818
Mazères (R.), Palæolithic Man in Brittany, 352
Mead (G.), awarded the Taylor gold medal of the Royal Aeronautical Society, 1094
Meddlicott (Col. H. E.), Oil Transport in the Middle East, 312
Mee (A. J.), Practical Organic Chemistry (*Review*), 634; Volumetric Analysis (*Review*), 831
Meek (Dr. C. K.), Law and Authority in a Nigerian Tribe: a Study in Indirect Rule (*Review*), 826
Meek (J. M.), [Dr. T. E. Allibone and], Development of the Spark Discharge, 804
Mees (Dr. C. E. K.), Photography (*Review*), 566
Meggy (A. B.), and Prof. R. Robinson, A Diene Synthesis Applicable to the Sterol Group, 282
Megson (N. J. L.), and W. A. Wood, Examination of Synthetic Resins by X-Rays, 642
De Meillon (B.), A Cage Colony of *Anopheles gambiæ* Giles, 428
Mellanby (Dr. Helen), appointed part-time demonstrator for medical and dental students in Sheffield University, 735
Mellon (A.), [death], 393
Melville (Dr. H. W.), Catalytic Reactions (*Review*), 827; [J. L. Bolland and], *Analysis of Ternary Gas Mixtures* by Thermal Conductivity Measurements, 63
Mendel (Dr. B.), and Miss F. Strelitz, Specific Action of Ferricyanide on Ærobic Glycolysis of Tumour Cells, 771
Menshutkin (Prof. B. N.), Trudy M. V. Lemonosova po *Fisike i Chimii* (*Review*), 784
Menzies (W. J. M.), Migrations of Salmon, 326
Metcalfe (G.), appointed Frank Smart student in botany of Cambridge University, 735
Meusel (Prof. A.), Man and the Machine Age (*Review*), 45
Meyer (E. A.), A Managed Gold Standard, 354
Meyer (Prof. K. H.), and N. P. Badenhuizen, jun., Transformation of Hydrate Cellulose into Native Cellulose, 281
Meyer (Prof. S.), Lord Rutherford, 1047
Miall (L. M.), [Dr. S. Miall and], Chemistry, Matter and Life (*Review*), 300
Miall (Dr. S.), and L. M. Miall, Chemistry, Matter and Life (*Review*), 300
Michaelson (Prof. J. W.), [death], 226; [obituary article], 308
Michell (Prof. J. H.), and M. H. Belz, The Elements of Mathematical Analysis. 2 Vols. (*Review*), 631
Miescher (Dr. K.), W. H. Fischer and E. Tschopp, The Effect of Enol-Esters of Testosterone, 726
Mihul (Constantin), [Mme. Irène Mihul and], Ionization of the Lower Part of the Ionosphere, 694
Mihul (Mme. Iréne), and Constantin Mihul, Ionization of the Lower Part of the Ionosphere, 694
Miles (A. A.), appointed professor of bacteriology at University College Hospital Medical School, 166
Milhoud (A.), Inflammation of Dirigible Balloons, 518
Millar (O. M.), [W. L. G. Joerg and], Map of Ellsworth Trans-Antarctic Flight, 648
Millard (W. S.), [late Rev. E. Blatter and], Some Beautiful Indian Trees (*Review*), 633
Miller (N. C. E.), Lac in Malaya, 510
Millikan (Prof. R. A.), [Prof. I. S. Bowen, Dr. H. V. Neher and], Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts, 23
Mills (J. P.), The Rengma Nagas (*Review*), 564
Milne (Prof. E. A.), elected president of the London Mathematical Society, 1094
Milnthorpe (Miss W.), [Dr. B. P. Uvarov and], Locust Outbreak in Africa and Western Asia, Fifth Survey of the, 33
Minakami (T.), [R. Takahasi and], Precursors of a Volcanic Eruption, 470

Minnis (C. M.), [Prof. K. G. Emeléus, E. B. Cathcart and], Electrical and Optical Properties of Iodine Vapour, 251
Minohara (T.), and Y. Ito, Ionosphere Observations in Japan During a Solar Eclipse, 814
Misch (L.), and van der Wyk, Structure of Crystallized Azulene, 737
Mitlacher (M.), [H. Benndorf and], Stationary Air Currents in Closed Vessels, 1112
Mitra (A.), Some Plant Diseases and Pests of India and their Control, 272
Mitra (Prof. S. K.), and K. K. Roy, Anomalous Dielectric Constant of Artificial Ionosphere, 586; Anomalous Dielectric Constant of Artificial Ionosphere, 1066
Miyabe (Naomi), Results of Re-levelling in Kyûsyû, Japan, 695
Miyabe (Prof. N.), Crust Displacements in Japan, 776; Sanriku Earthquake Seawaves of 1936, 1020
Moffat (C. B.), Mammals of Ireland, 292
Mohan (Margaret), J. Keane and T. J. Nolan, Chemical Constituents of Lichens found in Ireland: *Parmelia conspersa* Ach., 376
Moir (Reid), and Mr. and Mrs. MacAlpine Woods, Ancient Man in Devon, 367
Mokhtar (M.), and Dr. A. M. Mosharrafa, Modes in Modern Egyptian Music, 548
Molisch (Prof. H.), [death], 1043
Molisch (H.), Influence of One Plant on Another which is Remote from It, 125
Monguillon (P.), [M. Lemoigne, R. Desveaux and], Reduction of Nitric Acid to Hydroxylamine by the Higher Plants, 293
Monnier (D.), B. Susz and E. Briner, Raman Spectra of Acrylic Acid and of Methyl Methacrylate, both Monomer and Polymerized, 737
Mönnig (H. O.), A New Blow-fly Repellant, 812
Montandon (Prof. G.), La civilisation Aïnou et les cultures arctiques (*Review*), 386
Montel (Prof. P.), elected a member of the section of geography of the Paris Academy of Sciences, 104
de Montessus de Ballore (Count Robert), [obituary article], 226
Mookherji (A.), [Prof. K. S. Krishnan and], Magnetic Anisotropy of Rare Earth Sulphates and the Asymmetry of their Crystalline Fields, 549; Crystal Structure and the Magnetic Anistropy of CuSO$_4$·5H$_2$O, 896
Moon (A. E.), Bright Meteor of November 9, 1102
Moore (Dr. A. R.), Structure of Protoplasm, 367
Moore (E. J.), Biology for Students of Pharmacy (*Review*), 633
Moore (Sir John), [death], 716
Moore-Brabazon (Lt.-Col. J. T. C.), Interpretations of Atomic Constitution, 893; 971
Morgan (Dr. A.), conferment upon, of an honorary doctorate by Edinburgh University, 80
Morgan (Sir Gilbert), Scientific Aspect of Chinese Glazes (*Review*), 382; and Dr. G. R. Davies, Preparation of Germanium and Gallium, 688
Morgan (W. W.), Classification of Stellar Spectra, 430
Morioka (S.), [H. Endô and], Magnesium Alloys, 978
Moritz (Dr. A.), Population Policy in Germany, 678
Morley (Prof. F.), [death], 716; [obituary article], 880
Morris (L. E.), and R. H. Richharia, Crosses between Radish and Turnip, 285
Morris (Dr. N.), appointed professor of materia medica and therapeutics in Glasgow University, 556
Morrison (W. M.), Aluminium Manufacture in Great Britain, 163
Morton (Dr. R. A.), [Dr. J. R. Edisbury, G. W. Simpkins and], A Possible Vitamin A$_2$, 234; [Dr. J. A. Lovern, Dr. J. R. Edisbury and], A New Source of Vitamin A, 276
Mosallam (S.), [Prof. D. H. Bangham, Z. Saweris and], Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces, 237
Mosharrafa (Dr. A. M.), [M. Mokhtar and], Modes in Modern Egyptian Music, 548
Moszkowicz (O.), [H. Mache and], Ionization of Air at Low Pressures by γ-Rays, 1074
Mott (Prof. N. F.), A Theory of Light Action and Latent Image Formation, 997; [R. W. Gurney and], Photolysis of Silver Bromide and the Photographic Latent Image, 1073
Mottram (Dr. J. C.), [Dr. I. Doniach and], Sensitization of the Skin of Mice to Light by Carcinogenic Agents, 588; Photodynamic Action of Carcinogenic Agents, 933
Moureu (H.), M. Magat and G. Wétroff, Raman Spectra of the Two Forms of Phosphorus Pentachloride, 598; Stereochemical Structure of Phosphorus Pentachloride, 863
Moy-Thomas (J. A.), re-elected lecturer in zoology at Christ Church, Oxford University, 38
Mukerjee (Prof. R.), Theory and Art of Mysticism (*Review*), 636
Müller (Dr. A.), Structure of Metals, 1011
Mullick (D. N.), and Dr. J. T. Irving, Nutritional Value of some Indian Diets, 319
Munch (R. H.), [F. T. Gucker, jun. and], Nature of Calomel Vapour, 648
Munro (G. H.), [Dr. D. F. Martyn and], Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions, 603
Munro (S. S.), [Prof. F. A. E. Crew and], Gynandromorphism and Lateral Asymmetry in Birds, 1027
Murati (K.), [Prof. M. Nakaidzumi, Y. Yamamura and], Biological Effects of the Rays Produced by a Cyclotron, 359
Murphy (Major P.), [death], 184
Murphy (Dr. W. P.), A Weakness of Medical Research, 901
Murray (Dr. M. M.), Fluorine Poisoning (*Review*), 483
Myers (Dr. C. S.), In the Realm of Mind: Nine Chapters on the Applications and Implications of Psychology (*Review*), 705
Myers (Dr. G. N.), appointed demonstrator in pharmacology in Cambridge University, 123
Myers (R. J.), [Prof. W. D. Harkins and], Viscosity of Monomolecular Films, 465

Nachmansohn (D.), Choline Esterase in the Central Nervous System, 427
Nagai (Mary), and G. L. Locher, Production of Mutations by Neutrons, 111
Nagaoka (H.), and T. Ikebe, Magnetic Variation during an Explosion of Asamayama, and its Mechanism, 695
Nakaidzumi (Prof. M.), K. Murati and Y. Yamamura, Biological Effects of the Rays Produced by a Cyclotron, 359
Nakaya (Prof. U.), and others, Snow Crystals, 345
Nandi (Dr. H. K.), Trisomic Mutations in Jute, 973
Nash (Prof. A. W.), Education and Training for the Oil Industry, 459; [M. Ba Thi, T. G. Hunter and], and others, Solvent Dewaxing, 1105
Natanson (S.), Position of Maximum Optical Sensitivity of Sensitized Photographic Plates, 198
Nath (N. S. Nagendra), β-Decay as Due to a Neutrino Shower, 278
Naylor (G. F. K.), Occurrence of Palæozoic Strata near Taralga, N.S.W., 377
Nebel (B. R.), Mechanism of Polyploidy through Colchicine, 1101
Needham (Dr. Dorothy M.), and R. K. Pillai, Coupling of Dismutations with Esterification of Phosphate in Muscle, 64
Needham (Dr. J.), Latin Clarity and the Sciences of Life (*Review*), 664; Integrative Levels: a Revaluation of the Idea of Progress (Herbert Spencer lecture), 679; and H. Lehmann, Glyceraldehyde and Embryonic Glucolysis, 198
Neher (Dr. H. V.), [Prof. I. S. Bowen, Prof. R. A. Millikan and], Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts, 23
Němec (Prof. B.), Duše Rostlin (The Soul of Plants), (*Review*), 1081

Němec (Prof. B.), and others, Gold in Plant Ash, 73
Neuberg (Prof. K.), sixtieth birthday of, 21 ; work of, 923
Neugebauer (T.), A Theory of Ball Lightning, 814
Neumann (M.), and P. Toutakin, Dissociation of Peroxides and the Cold Flame of Hydrocarbons, 598
Neuss (Dr. J. D.), [Prof. W. Rieman, III and], Quantitative Analysis : a Theoretical Approach (*Review*), 914
Nevin (T. E.), Rotational Analysis of the Visible O_2^+ Bands, 1101
Newman (W. A. C.), [Sir Thomas Kirke Rose and], The Metallurgy of Gold. Seventh edition (*Review*), 258
Newsham (J. C.), The Horticultural Note Book. Fifth impression (*Review*), 527
Newton (H. W.), and H. J. Barton, Bright Solar Eruptions and Radio Fadings in 1935–36, 688
Neyman (Dr. J.), [Prof. E. L. Dodd and], An International Conference on the Theory of Probability, 938
Nice (Margaret N.), Population Study of the Song Sparrow, 159
Nichols (Prof. E. L.), [death], 960
Nicolau (A.), Thermomagnetic Study of Two Paramagnetic Solutions, 905 ; Thermomagnetic Properties and Constant Paramagnetism of the Ion UO_2^{++} in some Uranyl Salts in Aqueous Solution, 985
Nielsen (N.), [Prof. G. Hevesy, Dr. K. Linderstrøm-Lang and], Phosphorus Exchange in Yeast, 725
Niggli (Prof. P.), Mineral Chemistry and Crystal Structure (*Review*), 783 ; Das Magma und seine Produkte. Teil 1 : Physikalisch-chemische Grundlagen (*Review*), 913
Nikitin (B. A.), Chemical Properties of the Rare Gases, 643
Nilakantan (P.), Temperature Variation of Magnetic Anisotropy of Organic Crystals, 29
Nishini (Dr. Y.), and C. Ishii, A Cosmic Ray Burst at a Depth Equivalent to 800 m. of Water, 774
Nitta (I.), and T. Watanabé, Hydrogen Bridges in Solid Pentaerythritol, 365
Nobbs (P. E.), Design : a Treatise on the Discovery of Form (*Review*), 873
Nocht (Prof. B.), eightieth birthday of, 845 ; award of Bernhard Nocht medals to Prof. J. Rodhain, Prof. E. Brumpt, Dr. W. Fourneau, Prof. E. Martini, Prof. E. Reichenow, Dr. P. Manson-Bahr, Prof. G. H. F. Nuttall, Prof. E. P. Snijders, Prof. N. H. Swellengrebel, Prof. G. Bastianelli and Sir Aldo Castellani, 1009
Nolan (T. J.), [J. Breen, J. Keane and], Chemical Constituents of Lichens Found in Ireland—*Pertusaria concreta*, 333 ; [Margaret Mohan, J. Keane and], Chemical Constituents of Lichens found in Ireland : *Parmelia conspersa* Ach., 376
Nolf (P.), awarded the Grand Cross of the Order of Leopold, 104
Norman (J. R.), and Dr. F. C. Fraser, Giant Fishes, Whales and Dolphins (*Review*), 911
Norman (Dr. V.), Essentials of Modern Medical Treatment (*Review*), 486
Norris (M.), [Dr. R. Lemberg, B. Cortis-Jones and], An Oxyporphyrin Hæmatin Compound as Intermediate between Protohæmatin and Verdohæmatin, 65
Norrish (Prof. R. G. W.), and C. H. Bamford, Photodecomposition of Aldehydes and Ketones, 195
North (Dr. F. J.), Humphrey Lhuyd's Maps of England and of Wales, 813
Northrup (Dr. E. F.) (Akkad Pseudoman), Zero to Eighty : being My Lifetime Doings, Reflections and Inventions, also My Journey Around the Moon (*Review*), 872
Novak (F. V.), [Dr. F. Běhounek and], Retention of Radioactive Substances in the Body of Rats and the Lethal Dose, 106
Novák (Dr. J.), [Prof. J. Heyrovský], Overvoltage in Light and Heavy Water, 1022
Nuffield (Lord), gift to Oxford University for a new college ; other gifts by him, 679, 697 ; conferment upon, of a degree by Oxford University, 819
Numelin (Dr. R.), The Wandering Spirit : a Study of Human Migration (*Review*), 89
Nurnberger (C. E.), Ionization Theory and Radio-biological Phenomena, 83
Nuttall (Prof. G. H. F.), [death], 1087
Nuttall (G. R. F.), [Dr. H. M. Hyde and], Air Defence and the Civil Population (*Review*), 661
Nyrop (Dr. J. E.), The Catalytic Action of Surfaces. Second edition (*Review*), 827

Obata (J.), and R. Kobayashi, A Direct-Reading Pitch Recorder and its Applications to Music and Speech, 695
Ochoa (Dr. S.), appointed Ray Lankester investigator for 1937, 190 ; and C. G. Ochoa, Cozymase in Invertebrate Muscle, 1097
O'Connor (J. M.), [Prof. E. J. Conway, D. K. O'Donovan and], Influence of Temperature on the Activity of the Kidney in Relation to its Influence on Oxygen Consumption, 40
Odell (N. E.), Fjord Formation, 855
O'Donovan (D. K.), [Prof. E. J. Conway, J. M. O'Connor and], Influence of Temperature on the Activity of the Kidney in Relation to its Influence on Oxygen Consumption, 40
Oeser (Dr.), Factors of Vocational Guidance, 284
O'Gorman (Dr. M.), Designation of "The Time-Space Continuum", 773
Omer-Cooper (J.), Zoological Expedition to the Oasis of Siwa, Egyptian Libya, 919
O'Neale (Dr. Lila M.), Early Peruvian Textiles, 32
van Oorde-de Lint (G. M.), and J. H. Shuurmans Stekhoven, jun., Parasitic Copepods of the North Sea and Baltic, 686
Oppenheimer (Prof. C.), Die Fermente und ihre Wirkungen. Suppt. Lief. 6 (*Review*), 873
Orde-Powlett (Hon. Nigel), Present and Future of Estate Woodlands, 817
Orr (Dr. J. W.), elected reader in experimental pathology in Leeds University, 942
Ortmann (H.), [N. Riehl and], Effect of Pressure on Phosphors, 593
Orton (Prof. J. H.), Sex Biology of the Oyster and the Salmon, 68 ; Some Interrelations between Bivalve Spatfalls, Hydrography and Fisheries, 505 ; Oyster Biology and Oyster Culture : being the Buckland Lectures for 1935 (*Review*), 952
Ortvay (Prof. R.), Problem of Reality in Physics, 313
Osborn (A. W.), The Superphysical : a Review of the Evidence for Continued Existence, Reincarnation, and Mystical States of Consciousness (*Review*), 1078
Osborn (R.), Freud and Marx : a Dielectical Study (*Review*), 344
Osborne (Prof. W. A.), conferment upon, of an honorary doctorate of Queen's University, Belfast, 123 ; Why do Stranded Whales Die ?, 1017
Osgood (Dr. C.), Ethnography of the Tanaina, 898
van Overbeek (J.), Effect of the Roots on the Production of Auxin by the Coleoptile, 293
Owen (Dr. D.), Alternating Current Measurements at Audio and Radio Frequencies (*Review*), 637
Owens (Dr. J. S.), The Electrotor Smoke and Dust Meter, 331

Painter (W. H.), [Dr. V. K. Zworykin, Dr. R. R. Law and], Projection Television, 286
Palmer (W. G.), conferment upon, of a doctorate by Cambridge University, 1110
Paneth (Prof. F. A.), Meteorites : the Number of Pultusk Stones, and the Spelling of "Widmanstätten Figures", 504 ; 809
Pantin (Dr. C. F. A.), recommended for appointment as reader in invertebrate zoology in Cambridge University, 38 ; appointed reader in invertebrate zoology in Cambridge University, 904 ; and others, Transmission of Excitation in Living Material, 118
Paramasivan (S.), Technique of the Painting Process in the Temple of Vijayalaya Cholisvaran in Pudukottah State, 198

Paris (R.), [M. Maseré and], Constitution of Scoparoside (Scoparine) of *Sarothamnus scoparius*, 125

Parker (A.), Economic Position and Outlook in Germany, 541

Parker (G. H.), Colour Changes Due to Erythrophores in the Squirrel Fish, *Holocentrus*, 83 ; Colour Changes in Elasmobranch Fishes, 469

Parker (R. C.), [Prof. E. N. da C. Andrade and], Absolute Measurements of Sound Intensity, 34

Parkin (M.), Jebsen-Marwedel's Glastechnische Fabrikationsfehler (*Review*), 830

Parnell (I. W.), Control of Nematodes of Horses and Sheep, 686

Parodi (M.), Transmission of some Oxides in the Extreme Infra-Red, 208 ; Characteristic Frequencies of Chlorates, Bromates and Iodates, 943

Parr (G.), The Low Voltage Cathode Ray Tube : and its Applications (*Review*), 1032

Parrington (F. R.), appointed a lecturer in zoology in Cambridge University, 904

Partington (Prof. J. R.), Work of Prof. Richard Watson, 803 ; Chemistry in the Ancient World (Bedson lecture), 1006 ; and R. P. Towndrow, Heterogeneous Equilibria with Deuterium, 156 ; and Dr. D. McKie, Levity of Phlogiston, 1089 ; [E. G. Cowley and], Series Effect on the Dipole Moments of some Alkyl Halides, 1100

Paterson (C. C.), conferment upon, of an honorary doctorate by Birmingham University, 80 ; work of, 351 ; 717 ; Appraisement of Lighting (Guthrie lecture), 763

Paterson (T. T.), Palæolithic Succession in England, 775 ; appointed curator of the Cambridge Museum of Archæology and of Ethnology, 904

Patterson (E. L.), appointed assistant lecturer in anatomy in Manchester University, 207

Patterson (J. B. E.), Cobalt, and Sheep Diseases, 363

Patwardhan (Dr. S. S.), Palæmon, the Indian River Prawn, 580

Pauling (L.), and L. O. Brockway, Carbon-Carbon Bond Distances, 688

Pauthenier (M.), M. Feldenkrais and L. Vigneron, The Electrostatic Valve, 518

Peacock (Prof. A. D.), and Dr. Ann R. Sanderson, Maturation in the Thelytokously Partheno-Genetic Tenthredinidæ, 240

Peak (D. A.), Stereochemistry of the Sterols and the Bile Acids, 280

Peake (H. J. E.), Problems of the New Stone Age, 551

Pearce (R. R.), [Prof. W. Sucksmith and], The Paramagnetic Magneton Numbers of the Ferromagnetic Metals, 970

Pearl (Prof. R.), Problems of Population Density, 32 ; Need for the Study of Human Biology, 145

Pearse (Dr. H. L.), Effect of Hetero-auxine on the Growth of Broad Bean Plants in Water Culture, 26

Pearse (Dr. R. W. B.), [A. G. Gaydon and], Band Spectrum of Chromium Hydride, CrH, 110

Pearson (G. E.), conferment upon, of the Croix de Chevalier de la Légion d'Honneur, 315

Pearson (Prof. N. E.), Fishes of Paraguay, 510

Peczenik (O.), and L. Popper, Posterior Lobe of the Hypophysis and the Thyroid Gland, 821

Pedersen (K. O.), [A. Tiselius, Prof. The Svedberg and], Analytical Measurements of Ultracentrifugal Sedimentation, 848

Peek (B. M.), Physical State of Jupiter's Atmosphere, 776

Peierls (Dr. R.), [Dr. J. F. Allen, M. Zaki Uddin and], Heat Conduction in Liquid Helium, 62

Penney (Dr. W. G.), and G. J. Kynch, Absorption Spectra Evidence of the Decomposition of the Ground Term of Nd+++ Ion due to Crystalline Fields, 109

Pennington (Prof. S. C. B.), [death], 184 ; [obituary article], 225

Péquart (Marthe et Saint-Just), M. Boule et H. Vallois, Téviec : Station-nécropole mésolithique du Morbihan, 829

Porier (A.), The Torus Mandibularis and its Ultimate Phylogenic Signification, 737

Perkin (Prof. A. G.), [obituary article], 13

Perlmann (G.), [Dr. H. Herrmann and], Reaction between Proteins and Metaphosphoric Acid, 807

Pernier (Prof. L.), [death], 393 ; [obituary article], 495

Perren (J.), Equation of Solubility of a Pure Substance Forming a Solid Compound with the Solvent, 477

Perrier (C.), and Prof. E. Segrè, Radioactive Isotopes of Element 43, 193

Perrottet (E.), [E. Briner and], Complementary Results on the Catalytic Action of Ozone in the Oxidation of Aldehydes, 737

Perry (Sir Percival), conferment upon, of an honorary doctorate by Birmingham University, 80

Pessler (Dr. W.), Volkstumsatlas von Niedersachsen. Lief. 1 u. 2 (*Review*), 785

Peters (J. L.), Check-List of Birds of the World. Vol. 3 (*Review*), 1034

Petrovič (Dr. A.), Serbian Gypsy Feast-Days, 115

Pétry (P.), Interpretation of Observations and Measurements Relating to Breakers, 820

Pettersson (H.), Abundance Ratio of Thorium to Uranium in Rocks and in the Sea, 821

Pfeiffer (Dr. H. H.), Self-arrangement in the Mitotic Spindle under Mechanical Influence, 770

Philby (H. St. John), Archæological Exploration in Arabia, 885

Philip (G.), [death], 1043

Philip (Prof. J. C.), appointed deputy vice-chancellor of London University, 207

Phillips (D. W.), [H. M. Hudspeth and], Coal Measure Rocks. Part 1, 813

Phillis (Dr. E.), and Dr. T. G. Mason, Concentration of Solutes in Vacuolar and Cytoplasmic Saps, 370

Phillips (Dr. P.), [obituary], 393

Philpot (J. St. L.), elected a senior research fellow of Balliol College, Oxford, 694

Picard (Prof. L.), Fauna and Climate in Early Palestine, 497

Pickard (Sir Robert), elected vice-chancellor of London University, 207

Pielou (D. P.), [Dr. D. L. Gunn, J. S. Kennedy and], Classification of Taxes and Kineses, 1064

Pierce (E. L.), A Plankton Collector for Fast Towing, 1014

Piercy (Dr. N. A. V.), Aerodynamics (*Review*), 635

Piggott (S.), Origin of the Long Barrow, 1103

Pigott (S. J.), Progress of Marine Engineering, 539

Pillai (R. K.), [Dr. Dorothy M. Needham and], Coupling of Dismutations with Esterification of Phosphate in Muscle, 64

Pirotta (Prof. P. R.), [death], 455

Pittard (Prof. E.), Origins of Civilization and the Hittites, 677 ; and H. A. Seylan, Prognathism, Cranial Capacity and Area of the Occipital Perforation in the Anthropoids, 737

Plate (Prof. L.), [death], 922

Platonov (G. P.), [P. J. Schmidt and], Anabiosis and Fish Transport without Water, 557

Plomley (N. J. B.), and G. B. Thompson, Distribution of the Biting-Louse, 199

Plotnikow (Prof. J.), Allgemeine Photochemie. Zweite auflage (*Review*), 444

Pochin (E. E.), [T. Lewis and], Pain Nerves, 325

Pohl (R. W.), and others, Conduction of Electricity in Solids, 204

Polanyi (Prof. M.), Congrès du Palais de la Découverte International Meeting in Paris, 710

Pollak (L.), and G. Flaum-Fehér, Distribution of Sugar in the Body and the Action of Insulin, 821

Polunin (Dr. N.), The Birch 'Forests' of Greenland, 939

Ponsonby (Arthur), (Lord Ponsonby of Shulbrede), Life Here and Now : Conclusions Derived from an Examination of the Sense of Duration (*Review*), 341

Poole (Dr. H. H.), Measurement of Submarine Daylight, 50 ; A Convenient Form of Galvanometer Shunt for Use with Rectifier Photo-cells, 376

Poole (J. H. J.), A Synchronous Clock Time-marker, 376

Popper (L.), [O. Peczenik and], Posterior Lobe of the Hypophysis and the Thyroid Gland, 821

Porret (D.), and Dr. E. Rabinowitch, Reversible Bleaching of Chlorophyll, 321

Potts (F. A.), [death], 536 ; [obituary article], 575

Poulton (Sir Edward B.), The History of Evolutionary Thought as Recorded in Meetings of the British Association, 395

Poulton (Dr. E. P.), Heat Production, Nutrition and Growth in Man, 413

Praeger (Dr. R. L.), The Way I Went ; an Irishman in Ireland (*Review*), 870

Prain (Sir David), eightieth birthday of ; work of, 98

Preiswerk (Dr. P.), [A. Braun, P. Scherrer and], Detection of α-Particles in the Disintegration of Thorium, 682

Prentiss (Dr. A. M.), Chemicals in War : a Treatise on Chemical Warfare. With chapters on the Protection of Civil Populations and International Situation, by Major G. J. B. Fisher (*Review*), 3

Prettre (M.), Heterogeneous Combustion of Mixtures of Carbon Monoxide, Hydrogen and Oxygen on a Vitreous Surface, 251

Price (H. L.), appointed a faculty assistant lecturer in mathematics in Cambridge University, 476

Price (Dr. J. A.), appointed honorary demonstrator in medicine in Leeds University, 942

Price (W. C.), Rapports sur la photoluminescence présentés à la réunion internationale de photoluminescence, Varsovie, 20–25 Mai 1936 (*Review*), 787

Priestley (Prof. J. H.), Mechanism of Growth in Plants (*Review*), 257

Priestley (Dr. R. E.), appointed vice-chancellor of Birmingham University, 923, 942 ; work of, 923 ; the University and the National Life, 1007

Pringle (J. W. S.), appointed a demonstrator in zoology in Cambridge University, 1026

Pritchard (Capt. J. L.), Flight in the Stratosphere, 165

Proctor (Mary), and Dr. A. C. D. Crommelin, Comets : their Nature, Origin, and Place in the Science of Astronomy (*Review*), 566

Prosad (Prof. K.), and A. T. Maitra, Intensity and Structure Changes of the $L\alpha$ Emission Lines of Cu and Fe on Intense Cooling of their Anticathodes, 464

Pruvot (M.), Antarctic Polychaetes, 647

Pryde (A. W.), [Dr. E. B. Ludlam, H. Gordon Rule and], Optical Rotatory Power of Turbid Solutions in an Electric Field, 194

Pryor (M. G. M.), awarded a Frank Smart prize of Cambridge University, 123

Przedpelski (S.), [W. Broniewski, S. Sulowski and], Some Physical and Chemical Properties of Very Pure Steels, 334

Pseudoman (Akkad), (Dr. E. F. Northrup), Zero to Eighty : being My Lifetime Doings, Reflections and Inventions, also My Journey Around the Moon (*Review*), 872

Puddle (F. C.), Hybrids of the Rhododendron, 813

Pugh (B.), [Prof. W. T. David and], Influence of Hydrogen and Water Vapour upon the Combustion of Carbon Monoxide Mixtures, 1098

Pugh (W.), Mercurous Perchlorate as a Volumetric Reagent for Chlorides and Bromides, 656 ; [F. Serba and], Gallium (4), 656

Pugsley (A. G.), [Major B. C. Carter and], awarded the Edward Busk memorial prize of the Royal Aeronautical Society, 1094

Pullen-Burry (Miss B.), [obituary], 922

Pulley (Dr. O. O.), [Dr. A. L. Green and], Control of Phase Fading in Long-distance Radio Communication, 76

Pulling (Grace E.), The World from a Window Garden, 722

Purser (G. L.), Succession of Broods of *Lebistes*, 155

Purvis (O. N.), [Prof. F. G. Gregory and], Devernalization of Spring Rye by Anaerobic Conditions and Revernalization by Low Temperature, 547

Pye (Dr. D. R.), Metallurgy and the Aero Engine (autumn lecture of the Institute of Metals), 516

Pyman (Dr. F. L.), Researches in Chemotherapy, 409 ; Chemotherapy of Amœbicides, 832

Quick (H. E.), [A. R. Waterson and], *Gronemertes dendyi* Dakin, a Land Nemertean in Wales, 292

Quilliam (J. P.), awarded the university studentship in physiology in London University, 38

Quinet (Mlle. Marie Louise), Classification into Two Groups of the Complex Compounds of Magnesium Chloride with Oxygenated Organic Compounds, etc., 985

Rabinowitch (Dr. E.), [D. Porret and], Reversible Bleaching of Chlorophyll, 321

Rabkin (Dr. E. B.), Polychromatic Plates for Color Sense Examination (*Review*), 49

Radoïtchitch (Mlle. Milka), Influence of the Solvent on the Absorption Spectra of Neodymium Acetylacetonate, 81

Ragozina (M. N.), Neural Induction by Plant Tissues in the Ectoderm of the Gastrula of *Triton taeniatus*, 199

Rainey (R. C.), Absolute Configuration of the Naturally Occurring α Amino-Acids, 150

Raman (Sir C. V.), appointed professor of physics at the Indian Institute of Science, Bangalore, 232

Ramanathan (Dr. K. R.), Effect of Near Lightning Discharges on a Magnetometer, 587

Ramsay (Dr. J. A.), appointed Harding lecturer in experimental zoology in Cambridge University, 904

Ramsey (A. S.), Dynamics. Part 2 (*Review*), 217

Randall (J. T.), appointed to a Warren research fellowship, 232

Rao (B. Sundara Rama), [Prof. S. Bhagavantam and], Adiabatic and Isothermal Compressibilities of Heavy Water, 1099

Rao (N. K. A.), [Prof. B. N. Singh and], Changes in Chloroplast Pigments in Leaves during Senescence, 728

Rapson (Prof. E. J.), [obituary article], 839

Ratcliffe (J. A.), [K. G. Budden and], An Effect of Catastrophic Ionospheric Disturbances on Low-frequency Radio Waves, 1060

Rattray (Dr. R. S.), Indirect Rule in Nigeria (*Review*), 826 ; Religion and Medicine of a West African People (*Review*), 869

Raunkiaer (Prof. C.), translated by H. Gilbert-Carter, Plant Life Forms (*Review*), 1035

Raventos (J.), [A. J. Clark and], Pharmacology of Tetramethylammonium, 325

Rawdon-Smith (Dr. A. F.), [C. S. Hallpike, Prof. H. Hartridge and], Response of the Ear to a Phase Reversal, 74

Rawling (Dr. S. O.), Action and Theory of Photographic Development, 997

Rawlins (F. I. G.), The Natural Philosophy of Paintings, 219 ; Kremann's Zusammenhänge zwischen physikalischen Eigenschaften und chemischer Konstitution (*Review*), 831

Ray (A.), [Dr. A. Girard, G. Richard and], Antimicrobial Action of some Aromatic Compounds, 283

Rây (Sir P. C.), retirement from Palit professorship of chemistry at the Calcutta University College of Science and election as professor emeritus ; work of, 762

Rayleigh (Lord), The Light thought to have been seen in the neighbourhood of Alternate Current Magnets, 423 ; elected president of the British Association ; work of, 456 ; Surface Layers on Glass and Silica, 470

Raymond (Prof. A.), elected president of the International Congress of the History of Science and Technology, 1022

Raymond-Hamet and Colas, Botanical Origin of Chuchuhuasha, 334

Read (Prof. H. H.), Metamorphic Rocks of Unst, Shetland Island, 731

Read (Prof. J.), Sir David Orme Masson, 534 ; The Growth of Modern Chemistry (*Review*), 624

Reboul (G. and J.), Ionizing Radiations of Low Quantum emitted spontaneously by the Ordinary Metals, 1073

Reck (Prof. H.), [death], 309 ; [obituary article], 351

Reddi (K. R.), and Dr. V. Subrahmanyan, 'Sonti' Fermentation, 83

Redlich (Prof. O.), elected president of the Vienna Academy of Sciences, 332

Reeds (Dr. C. A.), Catalogue of the Meteorites in the American Museum of Natural History, 542
Reid (A.), [P. Evans and], Drilling Mud, 1025
Reimann (Dr. A. L.), Photo-conductivity and Phosphorescence of Zinc-blende, 501; Temperature Variation of the work functions of Clean and of Thoriated Tungsten, 1073
Reinig (W. F.), Die Holarktis (*Review*), 129
Reissner (M. E.), Theory of Beams Resting on a Yielding Foundation, 519
Renaud (Prof. E. B.), Prehistoric Archæology of North-Eastern New Mexico, 72
Rendle (Dr. A. B.), [W. Fawcett and], Flora of Jamaica. Vol. 7, late S. Le Marchant Moore and Dr. A. B. Rendle (*Review*), 302
Renier (Dr. A.), elected a foreign fellow of the Geological Society of London; work of, 883
Reynolds (J. H.), Observational Evidence for the Distribution of Matter in Space, 387
Reynolds (S. J. R.), appointed a demonstrator in anatomy in Cambridge University, 123
Reynolds (Dr. S. R. M.), Hæmodynamic Factors in the Uterus during the latter part of Gestation, 546
Rice (S. F.), awarded the Parsons scholarship in marine engineering of the Institution of Naval Architects, 722
Rich (T.), Devices for Fighting Fires, 271
Richard (G.), [Dr. A. Girard, A. Ray and], Antimicrobial Action of some Aromatic Compounds, 283
Richardson (F. D.), [Dr. C. F. Goodeve and], Existence of Chlorous Anhydride, 737
Richardson (L. J. D.), Axial Spin and Weapons of the Ancients, 1016
Richardson (L. R.), [W. J. Robbins, Mary A. Bartley, A. G. Hogan and], Pyrimidine and Thiazole Intermediates as Substitutes for Vitamin B_1, 779
Richharia (R. H.), [L. E. Morris and], Crosses between Radish and Turnip, 285
Richmond (Dr. H. W.), Prof. Frank Morley, 880
Rideal (Prof. E. K.), Surface Action in Biology, 671; [Prof. A. C. Cuthbertson, G. Gee and], The Kinetics of Polymerization, 889
Ridley (P.), [Dr. G. W. Brindley and], Asymmetry in Metals of Hexagonal Structure, 461
Ried (O.), Influence of Irradiated Metal Compounds on the growth and development of *Phaseolus vulgaris*, 335
Riehl (N.), [G. Graue and], Investigation of Porous Structure, 327; and H. Ortmann, Effect of Pressure on Phosphors, 593
Rieman, III (Prof. W.), and Dr. J. D. Neuss, Quantitative Analysis: a Theoretical Approach (*Review*), 914
Ries (Prof. H.), and Dr. T. L. Watson, Engineering Geology. Fifth edition (*Review*), 259
Rimington (Dr. C.), Porphyrins of the I and III Series in Congenital Porphyrinuria, 105; and G. C. S. Roets, Duality of the Coproporphyrins in Bovine Congenital Porphyrinuria, 584; [P. J. Fourie and], Living Animal Cases of Congenital Porphyrinuria, 68
Rinck (E.), Diagram of Solidification and Electrical Conductivity of the Rubidium-Cæsium Alloys, 518
Riou (P.), G. Delorme and H. Gamelin, Distribution of Manganese and Iron in the Conifers of Quebec Province, 1027
Ritchie (A. D.), appointed Sir Samuel Hall professor of philosophy and public administration in Manchester University, 207
Ritchie (Prof. J.), Natural History Outlook, 417; The Distribution of Animals (*Review*), 620
Riverdale (Lord), appointed chairman of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 888
Rivers (Dr. T. M.), appointed director of the Hospital of the Rockefeller Institute for Medical Research, 104
Robb-Smith (Dr. A. H. T.), appointed assistant director of pathology at the Nuffield Institute, Oxford University, 38
Robbins (W. J.), and Mary A. Bartley, Thiazole and the Growth of Excised Tomato Roots, 779; A. G. Hogan and L. R. Richardson, Pyrimidine and Thiazole Intermediates as substitutes for Vitamin B_1, 779; and F. Kavanagh, Intermediates of Vitamin B_1, and growth of Phycomyces, 943
Roberts (Dr. A. L.), National Smoke Abatement Society: Annual Conference at Leeds, 691
Roberts (E. J.), Grass Drying, 243
Robertson (Sir Charles Grant), resignation from Birmingham University, 694
Robertson (B. S.), appointed lecturer in regional anatomy in University College, Dundee, 207
Robertson (Dr. J. M.), [A. R. Ubbelohde and], A New Form of Resorcinol, 239
Robertson (Sir Robert), appointed director of the Salters' Institute of Industrial Chemistry, 722
Robinson (G. A.), [E. S. Byng and], Education in Industrial Management, 79
Robinson (late H. C.), and F. N. Chasen, The Birds of the Malay Peninsula. Vol. 3: Sporting Birds; Birds of the Shore and Estuaries (*Review*), 1034
Robinson (Prof. R.), [E. P. Abraham and], Crystallization Lysozyme, 24; [A. B. Meggy and], A Diene Synthesis applicable to the Sterol Group, 282
Robinson (W. H.), [Prof. N. A. Kent, Royal M. Frye and], Structure of Hα of Hydrogen, 236
Robson (J. M.), and Dr. A. Schönberg, Œstrous Reactions, including Mating, produced by Triphenyl Ethylene, 196
Rochester (G. D.), appointed assistant lecturer in physics in Manchester University, 207
Roets (G. C. S.), [Dr. C. Rimington and], Duality of the Coproporphyrins in Bovine Congenital Porphyrinuria, 584
Rogers (C. G.), [death], 960
Roholm (K.), Fluorine Intoxication (*Review*), 483
Rolleston (Sir Humphry), Historical Relations of Pharmacy and Physic, 676
Rolleston (Dr. J. D.), The Tobacco Habit, 615
Roos (S. E.), Antarctic Structure, 813
Rosanova (V.), [A. E. Gillam, Prof. I. M. Heilbron, Dr. E. Lederer and], Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils, 233
Rose (Sir Thomas Kirke), and W. A. C. Newman, The Metallurgy of Gold. Seventh edition (*Review*), 258
Rosen (A.), The Television Cable, 355
Rosenberg (Dr. H.), [Dr. J. B. Bateman, Dr. H. Loewenthal and], Alleged Specific Effects of High-frequency Fields on Biological Substances, 1063
Ross (Sir E. Denison), retirement of; work of, 185
Rossier (P.), Definition of Stellar Colour Indexes; the Wien-Planck Correction in the Calculation of the Magnitude of a Star, 125
Rothes (Earl of), appointed chairman of the governors of Faraday House Electrical Engineering College, 190
Rothschild (Lord), [death], 393; [obituary article], 574
Rotter (Dr. H.), Protective Effect against Experimental Rickets of Rats of a single massive dose of Vitamin D, 973
Roupell (Marion G.), Union Catalogue of the Periodical Publications in the University Libraries of the British Isles, with their respective holdings, excluding titles in the World List of Scientific Periodicals, 1934 (*Review*), 786
Roure (H.), [J. Bosler and], Disappearance of Brélas Comet, 40
Roussell (Dr. A.), and others, Researches into Norse Culture in Greenland, 52
Rousset (A.), New Measurements of the Factor of Depolarization of Light diffused by Argon, 251
Roussy (Dr.), elected rector of Paris University, 888
Rowe (Prof. F. M.), [E. J. Cross and], Prof. A. G. Perkin, 13
Roxby (Prof. P. M.), Geographical and Cultural Regions, 605
Roy (K. K.), [Prof. S. K. Mitra and], Anomalous Dielectric Constant of Artificial Ionosphere, 586; 1066
Roy (Ramesh Chandra), [Sarat Chandra Roy and], The Khãriãs, 2 Vols. (*Review*), 213
Roy (Sarat Chandra), and Ramesh Chandra Roy, The Khãriãs, 2 Vols. (*Review*), 213

Rule (H. Gordon), [Dr. E. B. Ludlam, A. W. Pryde and], Optical Rotatory Power of Turbid Solutions in an Electric Field, 194
Rumer (G.), [Dr. L. Landau and], Production of Showers by Heavy Particles, 682
Rushton (Dr. W.), Blindness in Freshwater Fish, 1014
Rushton (Dr. W. A. H.), Transmission of Excitation in Living Material, 118; appointed lecturer in physiology in Cambridge University, 123
Russell (Gen. F. F.), awarded the Buchanan medal of the Royal Society, 840; presented with the Buchanan medal of the Royal Society; work of, 980
Rutherford (Lord), The Search for the Isotopes of Hydrogen and Helium of Mass 3, 303; [death], 717; Prof. A. S. Eve, 746; Prof. J. Chadwick, 749; Sir J. J. Thomson, 751; Sir William Bragg, 752; Prof. Niels Bohr, 752; Prof. F. Soddy, 753; Prof. E. N. da C. Andrade, 753; Sir Frank Smith, 754; Funeral of, 754; further tributes to the late, Prof. S. Meyer, 1047; Prof. A. Norman Shaw; Prof. Niels Bohr, 1048; Prof. G. Hevesy, 1049; Duc de Broglie, 1050; Prof. J. Stark; Prof. O. Hahn, 1051; Prof. E. Fermi; Prof. L. Wertenstein, 1052; Dr. P. Kapitza, 1053
Van Rysselberghe (Prof. P.), [Prof. T. De Donder and], Thermodynamic Theory of Affinity (*Review*), 344

St. Joseph (Dr. J. K. S.), appointed a demonstrator in geology in Cambridge University, 123
Sainty (J. E.), Palæolithic Man in Norfolk, 731
Sakurai (Prof. J.), Beginnings of Western Science in Japan, 205; elected vice-president of the International Council of Scientific Unions, 641
Salaman (Dr. R. N.), The Potato in its Early Home and its Introduction into Europe (Masters lectures), 159
Salisbury (Prof. E. J.), Education and the Modern Study of Plants, 415; 669; 707
Salmon (Sir Isidore), Metric System and British Export Trade, 1089
Salt (Dr. G.), appointed a lecturer in zoology in Cambridge University, 904
Sampson (Prof. R. A.), retirement of; work of, 227
Sand (Dr. H. J. S.), The Sign and Symbol of Heat of Reaction, 809
Sanderson (Dr. Ann R.), [Prof. A. D. Peacock and], Maturation in the Thelytokously Parthenogenetic Tenthredinidæ, 240
Sang (J. H.), awarded a Hutchinson studentship for zoology at St. John's College, Cambridge, 476
Sansome (Dr. F. W.), The New Cytology (*Review*), 1033
Sarkar (S. N.). [Dr. S. R. Bose and], Enzymes of Wood-Rotting Polypores, 813
Sarnoff (D.), Science and Society, 459
Sato (M.), Barbels of Japanese Fish, 429
Saunders (Sir Charles E.), [death], 184
Saunders (Miss E. R.), Floral Morphology: a New Outlook, with special reference to the Interpretation of the Gynæceum. Vol. 1 (*Review*), 132
Saunders (Dr. K. J.), [obituary article], 1043
Saunders (O. A.), appointed Clothworkers' reader in applied thermodynamics at the Imperial College—City and Guilds College, London, 38
Savory (T. H.), Mechanistic Biology and Animal Behaviour (*Review*), 49
Saweris (Z.), [Prof. D. H. Bangham, S. Mosallam and], Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces, 237
Sawyer (W. W.), appointed an assistant lecturer in mathematics in Manchester University, 207
Sayers (J.), [Prof. K. G. Emeléus and], Negative Ions in Discharge Tubes, 1111
Scarborough (H.), [Dr. C. P. Stewart, Dr. P. J. Drumm and], Isolation of Ascorbic Acid from Urine, 282
Schapera (Prof. I.), Contributions of Western Civilization to Modern Kxatla Culture, 16
Schebesta (Dr. P.), translated by G. Griffin, Revisiting My Pygmy Hosts (*Review*), 445
Scherrer (P.), [A. Braun, Dr. P. Preiswerk and], Detection of α-Particles in the Disintegration of Thorium, 682
Schiller (Prof. F. C. S.), [death], 268; [obituary article], 454
Schintlmeister (J.), Redetermination of the Range of α-Particles from Thorium, 519; Shortening of the range of Polonium α-Particles by Oblique Emission from the Source, 821
Schlesinger (Dr. F.), An Annual Change in Longitudes, 1068
Schlesinger (H. I.), [A. B. Burg and], Borine Carbonyl, 74
Schmid (Dr. R.), and Dr. L. Gerö, Structure of a New System of CO Bands, 508
Schmidt (Prof. G. A.), Neural Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the Ectoderm of the Anuran Gastrula, 199
Schmidt (Prof. H.), Einführung in der Vektor- und Tensorrechnung (*Review*), 302
Schmidt (P. J.), and G. P. Platonov, Anabiosis and Fish Transport without Water, 557
Schmitz (H.), Irish Species of the dipterous family, *Phoridæ*. 1111
Schönberg (Dr. A.), [J. M. Robson and], Œstrous Reactions, including Mating, produced by Triphenyl Ethylene, 196
Schott (Prof. G. A.), [obituary article], 922
Schouten (J. F.), Role of Electric, Photo-chemical and Diffusion Phenomena in Vision, 41
Schramm (Prof. P. E.), translated by L. G. W. Legg, A History of the English Coronation (*Review*), 5
Schrödinger (Prof. E.), awarded the Planck medal of the German Physical Society, 722; World Structure (*Review*), 742
Schulman (Dr. J. H.), appointed assistant director of research in colloid science in Cambridge University, 291
Schwab (H.), Changes in the Hyperglycæmic Action of Adrenalin by the addition of Zinc Salts, 943
Scott (A. F.), and F. H. Hurley, Atomic Weight of Carbon, 1068
Scott (C. M.), Some Quantitative Aspects of the Biological Action of X- and γ-Rays, 936
Scott (K. G.), and S. F. Cook, Effect of Radioactive Phosphorus upon the Blood of Growing Chicks, 293; [S. F. Cook, P. Abelson and], Deposition of Radiophosphorus in Tissues of Growing Chicks, 944
Scott (R. B.), and F. G. Brickwedde, Liquid Parahydrogen, 1020
Scrase (F. J.), [Sir George Simpson and], Distribution of Electricity in Thunderclouds, 732
Sealy (J. R.), Classification in the Amaryllidaceæ, 73
Seaman (Prof. A. E.), [death], 309
Sebba (F.), and W. Pugh, Gallium (4), 656
Secrett (F. A.), Production of Early Vegetables and Salads under Glass, 887
Segrè (Prof. E.), [C. Perrier and], Radioactive Isotopes of Element 43, 193
Seiwell (H. R.), Consumption of Oxygen in Sea Water under Controlled Laboratory Conditions, 506
Sekiguti (Prof. R.), Coronal Emission Lines observed at the Total Solar Eclipse of June 19, 1936, 724
Seligman (G.), Physical Investigations on Falling Snow, 345; Snow Crystal or Snowflake? 730
Sellar (W.), Geometry of Conical Pipes, Bends and Joints, 900
Sen (B. K.), Volume-Rectification of Crystals, 1102
Sen (P.), Researches on Indian Fishes, 367
Senderens (Prof. J. B.), [death], 881
Servigne (M.), and E. Vassy, An application of Luminescence to Quantitative Analysis: the Micro-estimation of the Element Samarium, 124
Sesmat (Prof. A.), Systèmes de référence et mouvements (Physique classique). Parts 5, 6, 7 (*Review*), 994
Seward (Sir Albert), presentation of a portrait of, to the Botany School, Cambridge, 845
Seylan (H. A.), [E. Pittard and], Prognathism, Cranial Capacity and area of the Occipital Perforation in the Anthropoids, 737
Shapiro (B.), and Prof. E. Wertheimer, Action of Pancreatic Extract on Fatty Liver, 771

Shapter (R. E.), [H. C. Trumble and], *Associated Growth of Herbage Plants*, 1067
Sharples (A.), [death], 309; [obituary article], 494
Shaw (Prof. A. Norman), Lord Rutherford, 1048
Shaw (Sir Napier), conferment upon, of an honorary doctorate by Athens University, 104
Shaw (late Dr. Vernon), The Bournemouth Outbreak of Typhoid Fever, 145
Shearer (Dr. G.), X-Rays in Industrial Research, 1069
Shelford (V. E.), Animal Communities in Temperate America: as Illustrated in the Chicago Region—a Study in Animal Ecology (*Review*), 620
Shennan (Prof. T.), conferment upon, of an honorary doctorate by Aberdeen University, 123
Sheppard (Dr. G.), The Geology of South-Western Ecuador. With a chapter on the Tertiary Larger Foraminifera of Ecuador, by Dr. T. W. Vaughan (*Review*), 1035
Sheppard (Dr. S. E.), Dr. R. H. Lambert and R. D. Walker, *Mechanism of Optical Sensitizing of Silver Halides by Dyes*, 1096
Sherlock (Dr. R. L.), and others, Origin of the Red Rocks, 554
Shimadzu (S.), Oriental Crystallization, 978
Shimwell (J. L.), conferment upon, of a doctorate by Birmingham University, 1110
Shipton (E.), Problems of Conquering Everest, 394
Shorland (F. B.), New Zealand Fish Oils, 223
Shorter (A. W.), Prof. A. Erman, 309
Shryock (Prof. R. H.), The Development of Modern Medicine: an Interpretation of the Social and Scientific Factors Involved (*Review*), 386
Sidgwick (Prof. N. V.), The Organic Chemistry of Nitrogen. New edition, revised and rewritten by T. W. J. Taylor and Dr. W. Baker (*Review*), 4; awarded a Royal medal of the Royal Society, 840; presented with a Royal medal of the Royal Society; work of, 980
Siegbahn (Prof. M.), appointed Scott lecturer in Cambridge University for 1938–39, 1026
Silberblatt (A.), awarded the Denny naval architecture scholarship of the Institution of Naval Architects, 722
Sillifant (R. R.), Metal Spraying, 1105
Silsbee (Dr. F. B.), Supraconductivity, 420
Simonnet (H.), G. Guittonneau, G. Mocquot and A. Eyrard, *Influence of Pasteurization in the Absence of Air on the Nutritive Value of Milk*, 209
Simpkins (G. W.), [Dr. J. R. Edisbury, Dr. R. A. Morton and], *A Possible Vitamin A_2*, 234
Simpson (Sir George), Snow Crystal or Snowflake? 729; and F. J. Scrase, Distribution of Electricity in Thunderclouds, 732
Simpson (Dr. J. C. E.), Structure of β-Boswellinic Acid, 467
Simpson (J. F. Hope), elected a senior scholar in botany at Christ Church, Oxford University, 38
Sinclair (Dr. H. M.), elected an official fellow and tutor in physiology at Magdalen College, Oxford University, 38; Growth Factors for *Phycomyces*, 361
Singer (Prof. C.), Spirit of Science in History, 1021
Singh (Prof. B. N.), and N. K. A. Rao, Changes in Chloroplast Pigments in Leaves during Senescence, 728
Sinnott (E. W.), Relation of Gene to Character in Quantitative Inheritance, 83
Skinner (Dr. H. W. B.), and J. E. Johnston, *M-Emission Bands of Zinc, Copper and Nickel*, 508; Absorption Edges in the Soft X-Ray Region, 732
Sladden (Miss Dorothy), [obituary article], 184
Slade (F. H.), Electricity and Marketing, 311
Slade (Dr. R. E.), Grass and the Nation's Food Supply, 456; Grass Drying, 1089
Sloley (Sir Herbert), [obituary article], 674
Small (Dr. J. K.), The Proposed Everglades National Park, U.S.A., 263
Smallman (Lt.-Col.), Cancer: Memorandum on Provision of Radio-Therapeutic Departments in General Hospitals, 356
Smiles (Dr. Samuel), Memorial to, 537; 1004
Smith (Miss A. Lorrain), [death], 496
Smith (Dr. Edith Philip), Dr. A. H. Church, 268
Smith (Ernest A.), The Standard of Anglo-Saxon Silver Pennies, 1085
Smith (Eng.-Capt. E. C.), elected president of the Newcomen Society, 964
Smith (Sir Frank), Lord Rutherford, 754
Smith (J. L. B.), South African Fishes of the Families Sparidæ and Denticidæ, 334
Smith (Sydney), Early Sculpture from Iraq, 647
Smith (Dr. S.), appointed a demonstrator in zoology in Cambridge University, 1026
Smith (Prof. S. Parker), The Electrical Equipment and Automobiles: a Book of Principles for Motor Mechanics and Motorists. Third edition (*Review*), 704
Smithells (Dr. C. J.), Gases and Metals: an Introduction to the Study of Gas-Metal Equilibria (*Review*), 385
Smith-Rose (Dr. R. L.), Detection of Destructive Larvæ in Timber, 512
Smythies (E. A.), The Hailey National Park, 651
Snell (G. N.), and P. C. Aebersold, Production of Sterility in Male Mice by Irradiation with Neutrons, 779
Soddy (Prof. F.), Lord Rutherford, 753
Sokolow (A.), Neutrino Theory of Light in Three Dimensions, 810
Sonneborn (T. M.), Sex, Sex Inheritance and Sex Determination in *Paramecium aurelia*, 779
Spärck (R.), Benthonic Animal Communities of the Coastal Waters, 420
Spear [Tansley, Glücksmann and], Radiation and Cell Division, 686
Spearman (Prof. C.), Psychology Down the Ages. 2 Vols. (*Review*), 909
Speck (F. G.), Delaware Ceremonies and Dances, 32
Spencer (Dr. L. J.), elected a corresponding member of the Société Geologique de Belgique, 190; Tenham Meteoric Shower of 1879, 369; Meteorites: The number of Pultusk Stones and the spelling of "Widmanstätten Figures", 589; elected president of the Mineralogical Society, 888
Spengler (Dr. Carl), [obituary article], 797
Sperti (G. S.), Prof. J. R. Loofbourow and Sister Cecilia Marie Dwyer, Proliferation-promoting Substances from Cells Injured by Ultra-violet Radiation, 643
Spilhaus (Prof. A. S.), elected a foreign member of the Royal Meteorological Society; work of, 1058
Squire (Alderman C.), presidential address to the Museums Association, 164
Squire (F. A.), Nocturnal Habits of *Platyedra gossypiella* Saunders, 69
Srivasava (B. N.), [Dr. D. S. Kothari and], Joule-Thomson Effect and Quantum Statistics, 970
Stamp (Dr. L. Dudley), and others, Planning the Land of Britain, 791
Stamp (T. C.), appointed reader in bacteriology at the British Postgraduate Medical School, 778
Stanley (Dr. W. M.), Tobacco Mosaic Protein, 648
Stapledon (Prof. R. G.), Grassland Management in Great Britain, 99; The Hill Lands of Britain: Development or Decay? (*Review*), 1031
Stark (Prof. J.), Lord Rutherford, 1051
Staudinger (Prof. H.), Cellulose, Starch and Glycogen, 1071
Stebbing (Prof. E. P.), The Threat of the Sahara, 460
Stedman (R. E.), appointed lecturer in philosophy in University College, Dundee, 38
Stein (Sir Aurel), Archæological Reconnaissances in North-Western India and South-Eastern Iran (*Review*), 523
Archæological Reconnaissance in Southern Persia, 885; 925
Stekhoven, jun. (J. H. Schuurmans), [G. M. van Oorde-de Lint and], Parasitic Copepods of the North Sea and Baltic, 686
Stenz (Dr. E.), Number of Fragments of the Pultusk Meteorite, 113
Stepanow (A. W.), Artificial Slip Formation in Crystals, 64
Stern (Prof. C.), Interaction between Cell Nucleus and Cytoplasm, 770
Stern (F. C.), Garden Plants from China, 1093
Stetter (G.), [W. Jentschke and], Short-range Particles emitted when Polonium α-Particles are scattered by Heavy Nuclei, 821
Stewart (Dr. C. P.), H. Scarborough and Dr. P. J. Drumm, Isolation of Ascorbic Acid from Urine, 282

Stewart (Prof. J. Q.), and T. Stokley, Observation of the Longest Eclipse, 143

Stewart (Sir Thomas Grainger), (1837–1900); work of, 393

Stickland (Dr. L. H.), [Dr. L. P. Kendal and], The Initial Stages of Glycolysis in Muscle Extracts, 360

Stieda (Ludwig), centenary of the birth of; work of, 840

Stille (Prof. H.), elected a foreign correspondent of the Geological Society of London, 883; work of, 884

Stirling (Hon. G.), elected an honorary member of the Engineering Institute of Canada, 274

Stokley (T.), [Prof. J. Q. Stewart and], Observations of the Longest Eclipse, 143

Stone (Dr. Abraham), [Dr. Hannah M. Stone and], A Marriage Manual: a Practical Guide-book to Sex and Marriage. English edition, edited by M. Fielding (*Review*), 445

Stone (Dr. Hannah M.), and Dr. Abraham Stone, A Marriage Manual: a Practical Guide-book to Sex and Marriage. English edition edited by M. Fielding (*Review*), 445

Stone (W.), [F. W. Fox and], Specificity of Indophenol in the Estimation of Ascorbic Acid in Fermented Products, 234

Storks (K. H.), [L. H. Germer and], Structure of Langmuir-Blodgett Films of Stearic Acid, 779

Störmer (Prof. C.), Variations of Cosmic Ray Intensity during Magnetic Storms, 549; Divided Aurora Rays with one part in the Sunlit and another in the Dark Atmosphere, 1095

Stoughton (Prof. R. H.), and D. R. Hole, Photoperiodic After-Effect, 808

Stradling (Dr. R. E.), and others, Chemistry of Building Materials, 607

Stratton (Prof. F. J. M.), The Zodiacal Light at a Total Solar Eclipse, 682; Coronal Emission Lines observed at the Total Solar Eclipse of June 19, 1936, 725; elected president of the Committee on Science and its Social Relations (C.S.S.R.), 983; and others, The Solar Eclipse of June 19, 1936, 11

Streeter (Canon B. H.), [obituary article], 536

Strelitz (Miss F.), [Dr. B. Mendel and], Specific Action of Ferricyanide on Ærobic Glycolysis of Tumour Cells, 771

Strong (T. H.), [H. C. Trumble and], Associated Growth of Herbage Plants, 1067

Stuart (N.), Spiriform Morphology of some Lead Crystal Growths in Silica Gel, 589

Stubbings (G. W.), Commercial A.C. Measurements. Second edition (*Review*), 91

Stubbs (Rev. A. J.), Metric System and British Export Trade, 1089

Studebaker (Dr. J. W.), Adult Education in the United States, 816

Sturtevant (Dr. A. H.), and Dr. C. C. Tan, Linkage Relations of Parallel Mutations in *Drosophila*, 812

Subrahmanyan (Dr. V.), [K. R. Reddi and], 'Sonti' Fermentation, 33

Sucksmith (Prof. W.), and R. R. Pearce, The Paramagnetic Magneton Numbers of the Ferromagnetic Metals, 970

Suetsugu (T.), [Y. Ishida, I. Fukushima and], Determination of Electronic Charge by the Oil Drop Method, 29

Sugden (Prof. S.), appointed professor of chemistry at University College, London, 654

Sullivan (J. W. N.), [death], 309

Sulowski (S.), [W. Broniewski, S. Przedpelski and], Some Physical and Chemical Properties of very Pure Steels, 334

Sumner (F. B.), and P. Doudoroff, Some Quantitative Relations between Visual Stimuli and the Production or Destruction of Melanin in Fishes, 83

Sure (Prof. B.), The Little Things in Life: the Vitamins, Hormones and other Minute Essentials for Health (*Review*), 829

Susz (B.), [D. Monnier, E. Briner and], Raman Spectra of Acrylic Acid and of Methyl Methacrylate, both Monomer and Polymerized, 737

Sutherland (Dr. G. B. B. M.), Carbon-Halogen Distance in the Methyl Halides, 239; and G. K. Conn, Infrared Spectrum of Tetradeuteroethylene, 644

Svedberg (Prof. The), [A. Tiselius, K. O. Pedersen and], Analytical Measurements of Ultracentrifugal Sedimentation, 848

Swaffield (J.), [W. Alexander and], Magnetostriction, 1068

Swann (H. W.), Electrical Accidents and their Causes, 887

Sweeney (Miss Beatrice M.), [Prof. K. V. Thimann and], Action of Auxin on Protoplasmic Streaming, 807

Swinton (Dr. W. E.), Improvement of Museum Collections, 734

Sykes (C.), and H. Wilkinson, Transformation in the β-brass, 857

Symmers (Prof. W. St. Clair), [death], 611

Symms (L. S. T.), [Dr. R. v. d. R. Woolley and], Two Visual Binary Orbits, 160

Symonds (H. H.), Afforestation in the Lake District: a Reply to the Forestry Commission's White Paper of 26th August, 1936 (*Review*), 214

Syms (L. T. S.), The Orbit of $O\Sigma$ 79, 688

Synge (P. M.), Mountains of the Moon: an Expedition to the Equatorial Mountains of Africa (*Review*), 951

Synge (R. L. M.), appointed Benn W. Levy student in biochemistry in Cambridge University, 778

Szent-Györgyi (Prof. A.), awarded the Nobel prize for medicine; work of, 798; [A. Bentsáth and], Vitamin P, 426

Takahasi (R.), and T. Minakami, Precursors of a Volcanic Eruption, 470

Tan (Dr. C. C.), [Dr. A. H. Sturtevant and], Linkage Relations of Parallel Mutations in *Drosophila*, 812

Tansley, Spear and Glückmann, Radiation and Cell Division, 686

Tansley (Miss Katherine), conferment upon, of a doctorate by London University, 1110

Tarr (Dr.), Brood Diseases of Bees Investigations, 578

Tartar (H. V.), [W. H. Cone and], Passivity of Iron, 117

Tattersall (Prof. W. M.), New Species of Mysidacid Crustaceans, 775

Tauber (Dr. H.), Enzyme Chemistry (*Review*), 948

Tawde (Dr. N. R.), and S. A. Trivedi, Vibration Temperature in relation to Rotation Temperature in Band Spectra, 463

Taylor (A.), [A. J. Bradley, H. J. Goldschmidt, H. Lipson and], Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays, 543; [Dr. A. J. Bradley and], An X-Ray investigation of the cause of High Coercivity in Iron-Nickel-Aluminium Alloys, 1012

Taylor (G. T.), [K. C. Bailey and], Retardation of Chemical Reactions, 327

Taylor (H. S.), Heavy Hydrogen in Scientific Research (Bruce-Preller lecture), 124

Terrey (H.), conferment upon, of the title of reader by London University, 207

Thackeray (Dr. A. D.), appointed assistant director of the Solar Physics Observatory, Cambridge University, 80

Théodoresco (Mme. Marie), Study of the Raman Effect of Two Molybdotartaric Complex Compounds in Water, 209

Thimann (Prof. K. V.), and A. J. Haagensmit, Effects of Salts on Emergence from the Cyst in Protozoa, 645; and Miss Beatrice M. Sweeney, Action of Auxin on Protoplasmic Streaming, 807

Thiselton-Dyer (G. H.), Water Supplies and Town Planning, 963

Thode (H. G.), [Prof. H. C. Urey, M. Fox, J. R. Huffman and], Concentration of Nitrogen Isotope, 512

Thomas (Prof. F. W.), elected president of the ninth All-India Oriental Conference and a corresponding fellow of the Philosophical and Historical Section of the Prussian Academy of Sciences; work of, 55

Thomas (Prof. J. M.), Differential Systems (*Review*), 950

Thompson (Sir D'Arcy Wentworth), elected president of the Royal Society of Edinburgh, 766

Thompson (F. C.), [death], 455; [obituary article], 610

Thompson (G. B.), [N. J. B. Plomley and], Distribution of the Biting Louse, 199

Thompson (Dr. H. W.), and J. W. Linnett, Force Constants and Molecular Structure, 1065

Thompson (J. E.), [W. H. H. Cowles and], A Text Book of Trigonometry: for Colleges and Engineering Schools (*Review*), 344
Thompson (J. W.), W. Corwin and J. H. Asto-Salazar, Physiological Patterns and Mental Disturbances, 1062
Thompson (Prof. R. Campbell), elected Shillito reader in Assyriology in Oxford University, 38; elected a professorial fellow of Merton College, Oxford, 694
Thompson (W. P.), [J. W. Boyes and], Endosperm and Embryo in Reciprocal Cereal Crosses, 511
Thompson (W. R.), Moisture and Farming in South Africa (*Review*), 698; Science and Common Sense: an Aristotelian Excursion (*Review*), 872
Thomson (Prof. G. H.), Intelligence and Civilization (Ludwig Mond lecture), 59; Selection and Mental Factors, 934
Thomson (Prof. G. P.), awarded, with Dr. C. J. Davisson, the Nobel prize for physics; work of, 882
Thomson (Prof. J. G.), [death], 309; [obituary article], 495
Thomson (Sir J. J.), Lord Rutherford, 751
Thornley (S. K.), appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 680
Thornton (R. W.), [H. H. Curzon and], South African Native Cattle, 551
Thornton (Prof. W. M.), conferment upon, of the title of emeritus professor by Durham University, 435
Thornycroft (Sir J. E.), Evolution of Torpedo Craft, 763
Thorpe (Prof. J. F.), and Dr. M. A. Whiteley, Thorpe's Dictionary of Applied Chemistry. Fourth edition. Vol. 1 (*Review*), 1076
Tian (A.), and E. Gand, Ionic Dissociation of the Alkyl Halides, 293
Tiercy (G.), and P. Javet, Pulsation of Variable Stars of the Cepheid Type, 125
Tiessen (A. H.), [C. F. Brooks and], Meteorology of Great Floods in the Eastern United States, 511
Tilley (Prof. C. E.), Rock Magmas and Their Products (*Review*), 913
Tillyard (late Dr. R. J.), Fossil Insects from Kansas Rocks, 116; 1018; 1104
Timmermans (J.), and H. Bodson, Surface Tension of Water and that of Heavy Water, 293
Timoshenko (Dr. G.), Controlled Cathode Sputtering, 67
Tincker (Dr. M. A. H.), Relation of Growth Substances to Horticultural Practice, 594
Tiselius (A.), K. O. Pedersen and Prof. The Svedberg, Analytical Measurements of Ultracentrifugal Sedimentation, 848
Tissot (Prof. J.), Origin of Tuberculosis and Nature of the Tubercle Bacillus, 775
Todd (Dr. A. R.), appointed reader in biochemistry at the Lister Institute of Preventive Medicine, 778; Dr. F. Bergel, H. Waldmann and T. S. Work, Constituents of Vitamin E Concentrates from Rice- and Wheat-germ Oils, 361
Tolansky (Dr. S.), Atomic Spectra and Atomic Structure (*Review*), 626
Tomlinson (Miss M. L.), appointed a staff fellow of Girton College, Cambridge, 819
van Tongeren (W.), Gravimetric Analysis: a Laboratory Manual with special reference to the Analysis of Natural Minerals and Rocks (*Review*), 665
Toutakin (P.), [M. Neumann and], Dissociation of Peroxides and the Cold Flame of Hydrocarbons, 598
Towndrow (R. P.), [Prof. J. R. Partington and], Heterogeneous Equilibria with Deuterium, 156
Trask (Dr. P. D.), Origin of Oil, 857
Travers (A.), and R. Diebold, Isolation of Pure Cementite by Acid Attack of Ferrous Materials, etc., 1073
Travers (Prof. M. W.), Nitric Oxide and Alkyl Ethers, 107
Tréherne (G.), [G. A. Boutry and], Commutable and Stable Electrical Contacts, 251
van Trees (R.), Plants and the Dwelling-House, 420
Tritton (Sir Seymour), [death], 960
Trivedi (S. A.), [Dr. N. R. Tawde and], Vibration Temperature in relation to Rotation Temperature in Band Spectra, 463
Tropfke (Dr. J.), Geschichte der Elementar-Mathematik in systematischer Darstellung: mit besonderer Berücksichtigung der Fachwörter. Band 3. Dritte Auflage (*Review*), 255
Trumble (H. C.), and T. H. Strong; H. C. Trumble and R. E. Shapter, Associated Growth of Herbage Plants, 1067
Tsai (B.), [H. Bizette and], Magnetic Rotatory Power of Compressed and of Liquefied Nitric Oxide, NO, 208
Tschopp (E.), [Dr. K. Miescher, W. H. Fischer and], The Effect of Enol-Esters of Testosterone, 726
Tuck (J. L.), awarded a Salters' Institute fellowship, 274
Turin (J. J.), and H. R. Crane, The β-Rays from Lithium and Boron Isotopes, 776
Turnbull (C.), Kelvin and the Atomic Theory, 888
Turner (Eng.-Rear-Admiral A.), A Law of Hydrostatics and its Influence on the Shapes of Sailing Yachts, 597
Turner (Prof. W. E. S.), Twenty-one Years: a Professor Looks out on the Glass Industry, 1071
Turrill (Dr. W. B.), A New Species of *Sempervivum*, 1057; and others, Genetics and Toxonomy, 572
Tyler (A.), and N. H. Horowitz, Action of certain substituted Phenols on Marine Eggs in relation to their Dissociation, 779

Ubbelohde (R. R.), and Dr. J. M. Robertson, A New Form of Resorcinol, 239
Uddin (M. Zaki), [Dr. J. F. Allen, Dr. R. Peierls and], Heat Conduction in Liquid Helium, 62
Uemura (Y.), [B. Arakatsu, K. Kimura and], Expulsion of Neutrons from Lead by Cosmic Rays, 277
Unckel (H.), Deformation of the Macrostructure of some Two-phase Alloys by Cold-rolling, 857
Urban (Prof. F.), and Dr. M. D. Eaton, Spectroscopic Observations of Reactions between Lactoflavin, the Coulter Compound, 'Cytochrome *b*', and Cytochrome *c*, 466
Urey (Prof. H. C.), Heavy Nitrogen, 496; Recent Technical Processes, 901; M. Fox, J. R. Huffman and H. G. Thode, Concentration of Nitrogen Isotope, 512
Ushakov (Prof. M.), and A. Lutenberg, Oxidation of Cholesterol and Dehydroandrosterone by means of Osmic Acid, 466
Ushenko (Prof. A. P.), The Philosophy of Relativity (*Review*), 636
Uvarov (Dr. B. P.), and Miss W. Milnthorpe, Locust Outbreak in Africa and Western Asia, Fifth Survey of the, 33; Evolution of the Holarctic Fauna and Flora (*Review*), 129; Fundamentals of Zoogeography (*Review*), 663

Vahlen (Dr. T.), made an honorary professor in Greifswald University, 21
Valette (de La), Museum Study of Man and his Work, 1108
Van der Pijl (W. L.), Asiatic Flower-Birds and American Bird-Flowers, 775
Vassy (E.), [M. Servigne and], An application of Luminescence to Quantitative Analysis: the Micro-estimation of the element Samarium, 124
Vaughan (Dr. T. W.), Tertiary Larger Foraminifera of Ecuador (Geology of South-Western Ecuador) (*Review*), 1035
Vaultrin (R.), Utilization of Wood as Fuel for Motive Power, 59
Veit (O.), Die Tragik des technischen Zeitalters: Mensch und Maschine im 19 Jahrhundert (*Review*), 54
Venkateswaran (Dr. C. S.), The O–H Raman Frequency in Inorganic Acids, 151
Venkateswaran (Dr. S.), The Law of Trade and Merchandise Marks in India (*Review*), 342
Vernadsky (Prof. W. I.), B. K. Brunowsky and C. G. Kunasheva, Concentration of Mesothorium-I by Duckweed (*Lemna*), 317
Vernon (C. O.), awarded a Pilcher memorial prize of the Royal Aeronautical Society, 1094
Vernon (Dr. W. H. J.), and Dr. F. Wormwell, Corrosion of Water Mains and Services, 964

Viehfeger (F.), Loss of Charge of α-Particles in Helium, 125

Vigneron (L.), [M. Pauthenier, M. Feldenkrais and], The Electrostatic Valve, 518

Villat (Prof. H.), Count Robert de Montessus de Ballore, 226

Virchow (Prof. H.), eighty-fifth birthday of, 641

Virtanen (Prof. A. I.), Associated Growth of Legumes and Non-Legumes, 248; Excretion of Nitrogen Leguminous Plants, 683

Voelcker (Dr. J. A.), [death], 839; [obituary article], 1001

Voitkevič (A. A.), Morphogenetic Activity of Different Parts of the Hypophysis (3 and 4), 599; (5), 821

Vosburgh (W. C.), [R. G. Bates and], Potential of the Iodine Electrode, 776

Waddington (A. G.), [G. B. Brooke and], Determination of Alumina in Metallic Aluminium, 858

Wade (S. H.), awarded a Salters' Institute fellowship, 274

de Waal (J.), [E. Havinga and], Monomolecular Films, 160

Wager (Elizabeth M.), [H. G. Wager and], Annual Changes in the Osmotic Value of some Arctic and Temperate Plants, 376

Wager (H. G.), and Elizabeth M. Wager, Annual Changes in the Osmotic Value of some Arctic and Temperate Plants, 376

Wald (Dr. G.), Photo-labile Pigments of the Chicken Retina, 545; and H. Zussman, Carotenoids of the Chicken Retina, 197

Waldie (J. S. L.), Prof. S. Pennington, 225

Waldmann (H.), [Dr. A. R. Todd, Dr. F. Bergel, T. S. Work and], Constituents of Vitamin E Concentrates from Rice- and Wheat-germ Oils, 361

Walker (Sir Gilbert), Mechanics of Sport, 567

Walker (R. D.), [Dr. S. E. Sheppard, Dr. R. H. Lambert and], Mechanism of Optical Sensitizing of Silver Halides by Dyes, 1096

Wall (Dr. T. F.), Magnetic Quality of Nickel Wire as influenced by the Surface, 238; Effect of Surface Treatment on Magnetic Permeability, 856

Wallace (E.), Activities of the Association of British Chemical Manufacturers, 719

Wallace (Dr. R. C.), The Higher Learning, 541

Walther (Prof. J.), [death], 184

Wambacher (Dr. Hertha), [Dr. Marietta Blau and], Measurement of the length of Proton Tracks by the Photographic Method, 252; awarded the Ignaz L. Lieben prize of the Vienna Academy of Sciences, 332; Disintegration Processes by Cosmic Rays with the Simultaneous Emission of several Heavy Particles, 585

Wang (T. H.), [C. Y. Chao and], Spacing of the Resonance Neutron Levels of Silver, Rhodium and Bromine Nuclei, 768

Ward (A. G.), awarded an external research studentship at Emmanuel College, Cambridge, 435

Ward (Dr. A. J.), Theory and Practice of the Calculus (*Review*), 631

Ward (Prof. H. B.), Migrations of Salmon, 355

Wardlaw (Dr. W.), appointed professor of physical chemistry at Birkbeck College, 207

Warington (Miss Katherine), Boron in Agriculture, 1016; conferment upon, of a doctorate by London University, 1110

Warne (L. G. G.), Effect of Spraying Solutions of Growth Substances on the Inflorescences of the Florists' Chrysanthemum, 1065; and A. A. Jackson, Skatole as a Root-forming Substance, 26

Warren (F. L.), [F. G. Baddar and], Synthesis of Benzanthrones, 321

Warwick (Countess of), gift of Easton Park, Dunmow, as a Nature Reserve, 800

Watanabé (T.), [I. Nitta and], Hydrogen Bridges in Solid Pentaerythritol, 365

Waters (Dr. W. A.), Decomposition of Benzene-Diazonium Chloride, 466; (Dr. D. H. Hey and], Free Radicals in Solution, 934

van Waterschoot van der Gracht (Dr. W. A. J. M.), elected a foreign fellow of the Geological Society of London; work of, 883

Waterson (A. R.), and H. E. Quick, *Geonemertes dendyi* Dakin, a Land Nemertean in Wales, 292

Watson (D. M.), West Middlesex Main Drainage, 733

Watson (Dr. G. W.), conferment on, of the title of emeritus professor by Leeds University, 778

Watson (J. W.), appointed assistant lecturer in geography in Sheffield University, 207

Watson (Prof. Richard), work of, 803

Watson (Dr. T. L.), [Prof. H. Ries and], Engineering Geology. Fifth edition (*Review*), 259

Watson, W., & Sons, Ltd., Centenary of, 844

Watson-Watt (R. A.), A. F. Wilkins and E. G. Bowen, Reflection of Radio Waves in the Atmosphere, 512

Watts (Prof. W. W.), A Century of Geological Investigation (*Review*), 915

Waud (Prof. R. A.), Production of Artificial Respiration by Rhythmic Stimulation of the Phrenic Nerves, 849

de Wavrin (Marquis), Mœurs et coutumes des indiens sauvages de l'Amérique de sud (*Review*), 344

Wayland (E. J.), Dry Crossing of the Nile, 811

Webster (H. C.), The γ-Rays of Polonium, 852

Weeks (Dr. C. C.), Prohibition and Cirrhosis of the Liver, 20

Weems (Lt.-Comdr. P. V. H.), Air Navigation: British Empire edition. Edited by A. J. Hughes and P. F. Everitt (*Review*), 630

Weidenreich (Prof. F.), Reconstruction of the entire Skull of an Adult Female Individual of *Sinanthropus pekinensis*, 1010; Sinanthropus VI, 1067

Weil-Malherbe (Dr. H.), Glycerophosphoric Dehydrogenase, 725

Weiss (Dr. E.), centenary of; work of, 310

Welch (Dr. G. B.), The number of Discriminable Colours, 28

Wells (Dr. A. F.), [Dr. F. G. Mann and], Phosphine and Arsine Derivatives of the Group I(*b*) Metals: Volatile Derivatives of Gold, 502

Wells (G. P.), [H. G. Wells, Dr. J. Huxley and], Science of Life Series. 9 Vols. (*Review*), 484

Wells (H. G.), *Star-Begotten*: a Biological Fantasia (*Review*), 171; The Informative Content of Education, 415; Dr. J. Huxley and G. P. Wells, Science of Life Series. 9 Vols. (*Review*), 484

Wells (R. C.), Chemical Analyses of Rocks and Minerals, 202

Welsh (Dr. J. H.), [Dr. L. H. Kleinholz and], Colour Changes in *Hippolyte varians*, 851

Wenger (P.), [C. Cimerman and], Micro-separation of Zinc by means of *o*-Oxyquinoline in Acetic Solution; Volumetric Micro-estimation of Zinc in Alkaline Solution, 737

Wortenstein (Prof. L.), Lord Rutherford, 1052

Wertheimer (Prof. E.), [B. Shapiro and], Action of Pancreatic Extract on Fatty Liver, 771

Wesenberg-Lund (Prof. C.), Ferskvandsfaunaen biologisk belyst: Invertebrata. Bind 1 and 2 (*Review*), 992

Wesenberg-Lund (E.), Gephyrea, 420

West (T. F.), [Dr. N. F. Goodway and], Conversion of β-Phellandrene into a derivative of α-Phellandrene, 934

Westblad (E.), A New Hydroid from Norway, 1104

Westenhöfer (Prof. M.), elected an honorary member of the Medical Association of Kinesiology, Buenos Aires, 358

Westergård (Dr. M.), Cytology of *Gagea spathacea*, 551

Westoll (T. S.), Cheek Bones of Teleostomes, 72

Weston (W. A. R. D.), [W. J. Dowson and], A Disease of Hawthorn, 116

Wétroff (G.), [H. Moureu, M. Magat and], Raman Spectra of the Two forms of Phosphorus Pentachloride, 598; Stereochemical Structure of Phosphorus Pentachloride, 863

Wetzler-Ligeti (C.), and Dr. B. P. Wiesner, Restropic Effects of Anterior Pituitary Extracts, 892

Wheeler (Dr. R. E. Mortimer), Town Life in Early Britain (Norman Lockyer lecture), 924

Wheeler (Prof. R. V.), awarded the medal of the Institution of Mining Engineers, 967

White (Dr. F. W. G.), and L. W. Brown, Annual Variation of the Absorption of Wireless Waves in the Ionosphere, 931
White (Miss Kathleen M.), Mytilus (*Review*), 633
White (Dr. P.), [Dr. S. J. Folley and], Response of the Pigeon Crop Gland to Prolactin: Inhibition by Œstradiol Monobenzoate, 505
Whiteley (A. L.), Photo-electric Control in Industry, 927
Whiteley (Dr. M. A.), [Prof. J. F. Thorpe and], Thorpe's Dictionary of Applied Chemistry. Fourth edition. Vol. 1 (*Review*), 1076
Whitlock (H. P.), The Story of the Gems: a Popular Handbook (*Review*), 703
Whitnah (C. H.), B. L. Kunerth and M. M. Kramer, Determination of Lactoflavin in Milk, 430
Whitrow (G. J.), Galileo and Mathematical Demonstration, 646
Whytlaw-Gray (Prof. R. W.), and others, Town Planning and Smoke Abatement, 691
Wiesner (Dr. B. P.), [C. Wetzler-Ligeti and], Restropic Effects of Anterior Pituitary Extracts, 892; and A. L. Bacharach, Effect upon Sex Behaviour of a Diet Deficient in Vitamin E, 972
Wiggers (Prof. C. J.), Physiology in Health and Disease. Second edition (*Review*), 133
Wildman (Dr. A. B.), Non-specificity of the Trio Follicles in the Merino, 891
Wilkins (A. F.), [R. A. Watson-Watt, E. G. Bowen and], Reflection of Radio Waves in the Atmosphere, 512
Wilkins [Kearns, Martin and], Egg-Killing Washes, 469
Wilkinson (B. G.), awarded a Frank Smart prize of Cambridge University, 123
Wilkinson (H.), [C. Sykes and], Transformation in the β-brass, 857
Willey (Prof. A.), Graded Mutations in Wings of a Stonefly, 112
Williams (Dr. E.), appointed lecturer in electrical engineering in Durham University, 435
Williams (F. E.), Natives of Mount Hagen, Papua, 115
Williams (Dr. G.), Kinetics of Catalysed Polymerization of Styrene, 363
Williams (G. Bransby), Storage Reservoirs (*Review*), 635
Williams (Miss Margaret I.), appointed assistant lecturer in applied physiology in Manchester University, 207
Williams (R. F.), Drift of Net Assimilation Rate in Plants, 1099
Williams (R. R.), [J. K. Cline, J. Finkelstein and], Synthesis of Vitamin B, 856
Williams (Dr. S. E.), [A. J. Higgs and], Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions, 603
Williamson (R. W.), edited by Dr. R. Piddington, Religion and Social Organization in Central Polynesia (*Review*), 1080
Williamson (W. O.), Darkening of some Commercial Titanium Dioxide in Daylight, 238
Wills (Capt. D. M.), Value of the Substations of the National Institute of Agricultural Botany, 843
Wills (Prof. L. J.), Glaciation of the Midlands, 409; The Pleistocene History of the West Midlands, 995; 1036
Wills (M. S.), awarded the Scott scholarship in physics of Oxford University, 166
Wills (Cadet Ralph), awarded the Howard prize of the Royal Meteorological Society, 21
Wilson (A. H.), The Theory of Metals: Based on an Essay awarded the Adams prize in the University of Cambridge, 1931–1932 (*Review*), 702
Wilson, jun. (Dr. E. B.), presented with the one thousand dollar award of the American Chemical Society, 888
Wilson (G. Fox), A Pest of the Rhododendron, 202; Root-Knot Eelworm, 898; Drilling of a Deep Pressure Test in India, 430
Wilson (Dr. H. E. C.), appointed lecturer in Pathological Biochemistry at the Royal Hospital for Sick Children, Glasgow, 654
Wilson (Miss Janet M.), A New Fungus Gall, 1019
Wilson (Prof. P. W.), Excretion of Nitrogen by Leguminous Plants, 154; and E. B. Fred, Mechanism of Symbiotic Nitrogen Fixation, 943
Wilson (W. C.), bequest to Cambridge University, 735
Wimpenny (R. S.), Biology of Plankton Animals, 284
Wimperis (H. E.), advising on Aeronautical Research in Australia, 722
Winbolt (S. E.), With a Spade on Stane Street (*Review*), 486; Archæological Evidence and 'Development', 764
Winge (Dr. Ö.), Succession of Broods in *Lebistes*, 467
Winge and Laustsen, Diploid and Haploid Colonies of a Yeast, 1104
Wingfield (C. A.), Function of the Gills of the Mayfly Nymph, *Cloeon dipterum*, 27
Winkel (A.), [D. Beischer and], Size of Particles Responsible for Ferromagnetism, 202
Winterbottom (A. B.), Polarimetric Studies of Oxide Film Formation on Metals, 364
Wiseman (Dr. J. D. H.), Basalts from the Carlsberg Ridge, 855
Witherby (H. F.), "The Handbook of British Birds", 199
Withers (T. H.), British Museum (Natural History). Catalogue of Fossil Cirripedia in the Department of Geology. Vol. 2: Cretaceous (*Review*), 873
Witts (A. T.), Television Cyclopædia (*Review*), 1032
Witts (Prof. L. J.), appointed a member of the Medical Research Council, 190; appointed Nuffield professor of clinical medicine in Oxford University, 819; and others, The Hæmorrhagic States, 243
Woldřich (Prof. J.), [obituary], 309
Wolf (E.), [W. J. Crozier, Gertrud Zerrahn-Wolf and], Specific Constants for Visual Excitation, 943
Woltjer, jun. (Dr. J.), Maintenance of the Pulsation in Cepheid Variables, 195
Wood (Sir Kingsley), Care and After-care of the Tuberculous, 101
Wood (Prof. R. W.), Recent Improvements in Diffraction Gratings and Replicas, 723
Wood (W.), [Dr. H. J. Gough and], X-Ray Methods in the Investigation of Failure in Service, 1069
Wood (W. A.), [N. J. L. Megson and], Examination of Synthetic Resins by X-Rays, 642
Woods (Mr. and Mrs. MacAlpine), [J. Reid Moir and], Ancient Man in Devon, 367
Woolley (Dr. R. v. d. R.), and L. S. T. Symms, Two Visual Binary Orbits, 160; [Sir Frank Dyson and], Eclipses of the Sun and Moon (*Review*), 991
Work (T. S.), [Dr. A. R. Todd, Dr. F. Bergel, H. Waldmann and], Constituents of Vitamin E Concentrates from Rice- and Wheat-germ Oils, 361
Wormald (H.), Bacteriosis of Cherry Trees, 285
Wormwell (Dr. F.), [Dr. W. H. J. Vernon and], Corrosion of Water Mains and Services, 964
Wright (Dr. A.), [Dr. R. C. Lord and], Structure of Carbon Suboxide, 856
Wright (D. A.), Structure and Resistance of Thin Metal Films, 107
Wright (Dr. F. E.), elected a foreign fellow of the Geological Society of London, 883; work of, 884
Wright (J.), British Grid System, 394
Wrinch (Dr. Dorothy M.), Patterns of Proteins, 244; Cyclol Theory of the Structure of Insulin, 286; Cyclol Hypothesis and the 'Globular' Proteins, 940
Wyckoff (Dr. R. W. G.), Virus Proteins, 648
van der Wyk [L. Misch and], Structure of Crystallized Azulene, 737
Wymer (F. J.), Transport in France, 1056

Yadoff (O.), Electrical and Mechanical Ageing of Copper Conductors under the Prolonged Action of the Electric Current, 251
Yamamoto (Prof. I.), Observations of the Solar Eclipse of June 8, 1937, 501
Yamamura (Y.), [Prof. M. Nakaidzumi, K. Murati and], Biological Effects of the Rays produced by a Cyclotron, 359
Yeates (Prof. T.), conferment upon, of the title of emeritu professor by London University, 1026
Yenko (F. M.), [L. Baena and], Effect of Moulds upon Tanning Liquors, 687

Yoe (Prof. J. H.), Chemical Principles with particular application to Quantitative Analysis (*Review*), 634; and R. T. Hall, Isotopes of Potassium, 34

Zakharin (K. G.), Polarization of the Solar Corona, 586
Zalessky (Prof. G.), Ancestors of some Groups of the Present-day Insects, 847
Zangwill (O. L.), awarded a Harold Fry studentship at King's College, Cambridge, 435
Zechmeister (Prof. L.), und Dr. L. v. Cholnoky, Die Chromatographische Adsorptionsmethode: Grundlagen, Methodik, Anwendungen (*Review*), 48
von Zeerleder (Prof. A.), translated by A. J. Field, The Technology of Aluminium and its Light Alloys (*Review*), 176
Zener (Dr. C.), Internal Friction of Wires, 895
Zerrahn-Wolf (Gertrud), [W. J. Crozier, E. Wolf and], Specific Constants for Visual Excitation, 943
Zeuner (Dr. F. E.), Pleistocene Relations in East Anglia and Germany, 647
Ziemecki (Dr. S.), Use of Krypton-filled Ionization Chambers for Cosmic Ray Measurements, 150
Zilva (Dr. S. S.), Vitamin P, 588
Zimens (K. E.), Polymorphic Changes of the Alkaline-Earth Carbonates, 202
Zondek (Prof. B.), Œstrogenic Substances in the Dead Sea, 240
Zussman (H.), [G. Wald and], Carotenoids of the Chicken Retina, 197
Zwarenstein (Dr. H.), Gonadotropic Activity of Amphibian Anterior Pituitary, 588; 656
Zwicky (F.), A New Cluster of Nebulæ in Pisces, 293
Zworykin (Dr. V. K.), W. H. Painter and Dr. R. R. Law, Projection Television, 286

TITLE INDEX

α-Amino-Acids, Naturally Occurring, Absolute Configuration of the, R. C. Rainey, 150
α-Phellandrene in Essential Oils, Detection and estimation of, A. J. Birch, 377
α-Phellandrene, derivative of, Conversion of β-Phellandrene into a, Dr. N. F. Goodway and T. F. West, 934
Aberdeen University, conferment of an honorary doctorate on Prof. T. Shennan, 123
Abyssinia, Naturalists in, [1837], 1072
A.C. Measurements, Commercial, G. W. Stubbings. Second edition (*Review*), 91
Academic Assistance Council, Third Report of the, 169
Acetaldehyde, Inflammation of, J. Baron and P. Laffitte, 477
Acetanilides, 2 : 6-Disubstituted, Evidence of restricted rotation about the N—C Bond in, Dr. L. Hunter and H. O. Chaplin, 896
Achanarras, Middle Devonian Fish Fauna of, C. Forster Cooper, 292
Acidosis and Off-flavoured Milk, Capt. H. Barkworth and L. W. L. Cole, 324
Acontias Linn., New Forms of the Genus, J. Howitt, 1028
Acoustical Conference, First International, 370
Actinium, Optical Spectrum of, Mlle. Willy A. Lub, 40
Adrenalin, Changes in the Hyperglycæmic Action of, by the addition of Zinc Salts, H. Schwab, 943
Adsorption Columns, A. L. Bacharach (*Review*), 48
Aerial Protection in Belgium, 1008
Aerodynamic and Electrodynamic Equations, N. P. Kasterin, 244
Aerodynamics : A Text-book of (*Review*), 175 ; Practical, Elements of, Prof. B. Jones (*Review*), 175 ; Dr. N. A. V. Piercy (*Review*), 635
Aero Engine, Metallurgy and the, Dr. D. R. Pye, 516
Aeronautical Research Committee, Report for 1935–36, 289
Aeroplanes Fly, Why, A. Elton and R. Fairthorne (*Review*), 1035
Affinity, Thermodynamic Theory of, Prof. T. De Donder and Prof. P. Van Rysselberghe (*Review*), 344
Afforestation in the Lake District : a reply to the Forestry Commission's White Paper of 26th August, 1936, H. H. Symonds (*Review*), 214
Africa ; East, Higher Education in, 781 ; (*Review*), 951 ; Central, Blood Groups in, R. Elsdon Dew, 927
African : Pleistocene Mammals (*Review*), 6 ; Agricultural Problems, Dr. B. A. Keen (*Review*), 698 ; Natives, Higher Education for, 781
Aftermath : a Supplement to the Golden Bough, Sir James George Frazer (*Review*), 260
Agricultural : Products as Raw Materials for Industry, Sir Harold Hartley (Mather lecture), 221 ; Research Council, awards made to P. J. Faulks, R. S. Russell, F. H. Malpress, J. Wilson, G. H. L. Dicker, J. W. Whittick, F. D. Asplin and Miss K. M. Massey, 274 ; Research in Great Britain, 421 ; Marketing Policy, A. N. Duckham, 887
Agriculture : Seventeenth International Congress of, at The Hague, 35 ; British, The Rehabilitation of, 76 ; State Intervention in, J. M. Caie, 416 ; State Intervention and, 601 ; Boron in, Miss Katherine Warington, 1016
Aïnou, La civilisation et les cultures arctiques, Prof. G. Montandon (*Review*), 386
Air : Altitude Record, World's, Flight-Lieut. M. J. Adam, 56 ; -Conditioning Unit, An, 101 ; Record, Long Distance, Col. M. Gromoff, 143 ; -Conditioning, Future of, 579 ; *Navigation : British Empire edition*, Lt.-Comdr. P. V. H. Weems. Edited by A. J. Hughes and P. F. Everitt (*Review*), 630 ; Defence and the Civil Population, Dr. H. M. Hyde and G. R. F. Nuttall (*Review*), 661 ; Raid Precautions (*Review*), 661 ; Memorandum No. 5, 967 ; Sir Samuel Hoare, 1044 ; Ionization of, at Low Pressures by γ-Rays, H. Mache and O. Maszkowicz, 1074 ; Currents, Stationary, in Closed Vessels, H. Benndorf and M. Mitlacher, 1112
Aldehydes and Ketones, Photo-decomposition of, Prof. R. G. W. Norrish and C. H. Bamford, 195
Alexander's Electric Telegraph, [1837], 984
Algebra, College, Lectures on, S. B. Dandekar (*Review*), 831
Alibert, Baron [1837], 777
Alkaline-Earth Carbonates, Polymorphic Changes of the, K. E. Zimens, 202
Alkyl : Ethers, Nitric Oxide and, Prof. M. W. Travers, 107 ; Halides, Ionic Dissociation of the, A. Tian and E. Gand, 293 ; Series Effect on the Dipole Moments of Some, E. G. Cowley and Prof. J. R. Partington, 1100
All-India Oriental Conference, Ninth, Prof. F. W. Thomas elected president of the, 55
Alloys : of Iron and Palladium, Identification of various phases by Magnetic Study and by the X-Rays in, R. Hocart and M. Fallot, 81 ; of Iron and Iridium, Magnetic properties of, M. Fallot, 820 ; Deformation of the Macrostructure of some Two-phase, by Cold-rolling, H. Unckel, 857 ; Metals and, Studies of, 857 ; of Silver, Tin and Mercury, Constitution of the, Dr. Marie L. V. Gayler, 858 ; of Iron and Rhodium, Magnetic Properties of, M. Follot, 905 ; Iron-Nickel-Aluminium, High Coercivity in, An X-Ray Investigation of the Cause of, Dr. A. J. Bradley and A. Taylor, 1012
Alternating Current Measurements at Audio and Radio Frequencies, Dr. D. Owen (*Review*), 637
Aluminium : Nuclear Moments of, D. A. Jackson and Dr. H. Kuhn, 110 ; Manufacture in Great Britain, W. M. Morrison, 163 ; and its Light Alloys, The Technology of, Prof. A. von Zeerleder. Translated by A. J. Field (*Review*), 176
Amaryllidaceæ, Classification of the, J. R. Sealy, 73
Amaryllids, Culture of, 861
Ambix, No. 1, 188
American : Documentation Institute, 273 ; Men of Science, Famous, J. G. Crowther (*Review*), 439 ; Museum of Natural History, Catalogue of Meteorites in the, Dr. C. A. Reeds, 542 ; Philosophical Society, Library of the, 615 ; Chemical Society, award of the Francis B. Garvan gold medal to Dr. Emma R. Carr ; presentation of the society's one thousand dollar award to Dr. E. B. Wilson, jun., 888 ; Earthquakes, Recent, 899 ; Academy of Arts and Sciences, Research Grants of the, 1106
Amino-Acids : a, naturally occurring, Absolute Configuration of the, R. C. Rainey, 150 ; Formation and Breakdown of, by Intermolecular Transfer of the Amino Group, Prof. A. E. Braunstein and M. G. Kritzmann, 503
Amines, Action of Nitrous Acid on, J. C. Earl and N. G. Hills, 1105
Ammonolatory : The Life Element, late Prof. H. E. Armstrong, 134
Amœbicides, Chemotherapy of, Dr. F. L. Pyman, 832
Amphibian Anterior Pituitary, Gonadotropic activity of, Dr. H. Zwarenstein, 588
Anabiosis and Fish Transport without Water, P. J. Schmidt and G. P. Platonov, 557
d'analyse, Exercices, Prof. G. Julia. Rédigés par Dr. G. Bourion. Tome 4 (*Review*), 445
Anaspides, Embryology of the Crustacean, V. V. Hickman, 1018
Ancient : Man in Devon, J. Reid Moir and Mr. and Mrs. MacAlpine Woods, 367 ; Monuments in France, 613 ; Civilizations, The Social Thought of the, Prof. Joyce O. Hertzler (*Review*), 914

Androgenic Endocrine Activity in the Female Mammal, Prof. A. Lipschütz, 892

Anglo-Egyptian Treaty Honours List, 310 ; -Saxon Silver Pennies, The *Standard of*, *Ernest* A. Smith, 1085

Angmering Roman Villa, Appeal for funds for the Excavation of, 228

Animal : Magnetism [1837], 476 ; Communities in Temperate America : as illustrated in the Chicago Region—a Study in Animal Ecology, V. E. Shelford (*Review*), 620 ; Geography, Ecological, Prof. R. Hesse. Prepared by W. C. Allee and K. P. Schmidt (*Review*), 620 ; Life, Wild, Conservation of, [*Review*), 1079 ; Year Book, The, Vol. 4. Edited by Dr. H. E. Bargmann (*Review*), 1079

Animals, The Distribution of, Prof. J. Ritchie (*Review*), 620

Anopheles gambiæ Giles, A Cage Colony of, B. de Meillon, 428

Antarctic : Polychaetes, M. Pruvot, 647 ; Structure, S. E. Roos, 813 ; Surveys : Work of the "Discovery" investigations (Bruce memorial prize lecture), J. W. S. Marr, 863 ; vegetation, 936

Anthropology : Applied, appointment of a standing committee on, 145 ; an Introduction to Primitive Culture, Prof. A. Goldenweiser (*Review*), 632

Antirrhinums, Rust-resistant, D. E. Green, 73

Anuran Gastrula, Ectoderm of the, Neural Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the, Prof. G. A. Schmidt, 199

Apophallus venustus, Life-history of, T. W. M. Cameron, 510

Apseudes, Feeding Mechanism of, R. Dennell, 469

Arabia, Archæological Exploration in, H. St. John Philby, 885

Archæological : Excavations in Great Britain, Recent, 352 ; Reconnaissances in North-Western India and South-Eastern Îrān, Sir Aural Stein (*Review*), 523 ; Evidence and 'Development', S. E. Winbolt, 764

Archæology, Racial Evolution and, Prof. H. J. Fleure (Huxley memorial lecture), 945, 981

Archives, The Science of, in South Africa, Lt.-Col. C. G. Botha, 374

Arctic : Weather Reports, 394 ; Racial History in the, Dr. A. Hrdlička, 577

η Argus, Outburst of, Observed by Herschel, [1837], 1026

Armstrong College, Research at, 273

Aromatic Compounds, Antimicrobial Action of some, Dr. A. Girard, A. Ray and G. Richard, 283

Arsine, Phosphine and, Derivatives of the Group I(*b*) Metals : Volatile Derivatives of Gold, Dr. F. G. Mann and A. F. Wells, 502

Art and Artists, Primitive (*Review*), 619

Asamayama, Magnetic Variation during an Explosion of, and its Mechanism, H. Nagaoka and T. Ikebe, 695

Ascorbic Acid : Specificity of Indophenol in the estimation of, in Fermented Products, F. W. Fox and W. Stone, 234 ; from Urine, Isolation of, Dr. C. P. Stewart, H. Scarborough and Dr. P. J. Drumm, 282

Ash, Alkalinity of the, and loss of Chlorine on Incineration, F. Baerts and R. Vandewijer, 943

Asiatic Flower-Birds and American Bird-Flowers, W. L. Van der Pijl, 775

ASLIB List, New, 147

Assam Origins in relation to Oceania, Dr. J. H. Hutton, 413 ; 487

Astrology, The Science of (*Review*), 701

Athenæum, The, and Meteorology [1837], 208

Athens University, conferment of an honorary doctorate on Sir Napier Shaw, 104

Atlantic : Air Mail Service, 56 ; Crossing, Fast, by Air, 581

Atlantischen Ozeans, Temperatur, Salzgehalt und Dichte an der Oberfläche des, G. Böhnecke. Lief 1 ; Atlas (*Review*), 704

Atmospheric : Pollution, Twenty-second report on, 101 ; Pressure at High Altitudes, Spectrum of Nitrogen and, R. Bernard, 930 ; Pollution, Conference on, 966

Atomic : Spectra : and Atomic Structure, Prof. G. Herzberg. Translated by Prof. J. W. T. Spinks ; Dr. S. Tolansky (*Review*), 626 ; and the Vector Model, A. C. Candler. 2 Vols. (*Review*), 626 ; Theory, Kelvin and the, C. Turnbull, 888 ; Constitution, Interpretations of, Lt.-Col. J. T. C. Moore-Brabazon, 893 ; Prof. E. N. da C. Andrade, 894 ; Constitution, Interpretations of, Lt.-Col. J. T. C. Moore-Brabazon, 971 ; Distances in Crystals, N. Elliott, 978 ; Constitution, Interpretation of, Prof. A. S. Eve, 1061

Augustus, Emperor, Bimillenary of the, 577

Aurora Borealis [1837], 736 ; Rays, Divided, with One Part in the Sunlit and another in the Dark Atmosphere, Prof. C. Störmer, 1095

Aurous Compounds : Constitution of, Gold Mirrors, Prof. C. S. Gibson, 583

Australia : Scientific and Industrial Research, Council for, tenth annual report, 18 ; and New Zealand, Science in, 231 ; Bioclimatic Zones of, Dr. J. Davidson, 265 ; Aeronautical Research in, H. E. Wimperis Advising on, 722 ; Horticultural Research in, 843 ; Aborigines of, 1004 ; Administration and the, 1044

Australian Aborigines, Representation of the, 798

Australia's Burden, 1029

Australopithecus, Discovery of a Lower Molar of, Dr. R. Broom, 681

Autobahnen, The German, 926

Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance, A. W. Judge. Third edition (*Review*), 704

Auxin : Effect of the Roots on the Production of, by the Coleoptile, J. van Overbeek, 293 ; Action of, on Protoplasmic Streaming, Prof. K. V. Thimann and Miss Beatrice M. Sweeney, 807

Avebury, Scheme for the Preservation of, 144

Axial Magnetic Suspension, Frictional Torque of an, Dr. J. T. Holmes and Prof. J. W. Beams, 30 ; Spin and Weapons of the Ancients, L. J. D. Richardson, 1016

Azande, Witchcraft, Oracles and Magic Among the, Dr. E. E. Evans-Pritchard (*Review*), 338

Azobenzene, The *Cis*-form of, G. S. Hartley, 281

Azulene, Crystallized, Structure of, L. Misch and van der Wyk, 737

β-Decay as Due to a Neutrino Shower, N. S. Nagendra Nath, 278

β-Boswellinic Acid, Structure of, Dr. J. C. E. Simpson, 467

β-Rays from Lithium and Boron Isotopes, D. S. Bayley and H. R. Crane ; J. J. Turin and H. R. Crane, 776

β-Brass, Transformation in, C. Sykes and H. Wilkinson, 857

β-Phellandrene, Conversion of, into a Derivative of α-Phellandrene, Dr. N. F. Goodway and T. F. West, 934

Babbage's "Bridgewater Treatise", [1837], 434

Bacon Factory, Hygiene in the, 60

Bacteria in the Old Sedimentary Rocks, New Data on the Existence of, L. Cayeux, 124

Bacterial Suspensions, Optical Properties of, P. Bonét-Maury, 985

Baffin Bay, Expedition to, 1937, 1083

Ball Bearings, Miniature, 539

Band Spectra, Vibration Temperature in Relation to Rotation Temperature in, Dr. N. R. Tawde and S. A. *Trivedi*, 463

Bantu Blood Groups, Dr. R. Elsdon Dew, 77

Barium, Surface Migration of, Dr. M. Benjamin and R. O. Jenkins, 152

Battersea Power Station, 720

B.D.H. Laboratory Chemicals, Catalogue of the, 803

Beams Resting on a Yielding Foundation, Theory of, M. E. Reissner, 519

Bee Research Committee, Dr. J. Anderson appointed representative of the Scottish Beekeeper's Association on the, 274

Bees : Investigations, Brood Diseases of, Dr. Tarr, 578 ; Management of, [1837], 984

Beit : Memorial Fellowships, elections to, 102 ; Fellowships for Scientific Research, award of, 148

Belfast : Queen's University : conferment of an honorary doctorate on Prof. W. A. Osborne, 123 ; conferment of honorary doctorates on Dr. G. C. Anderson, Sir E. Farquhar Buzzard, Dr. H. Morley Fletcher, Prof. E. W. H. Groves, Prof. S. P. Bedson, and Dr. A. Felix, 166
Belgian : Stratosphere Balloon Experiment, Dr. M. Cosyns, 54 ; Royal Academy of Sciences, award of the Gluge prize of physiology to Prof. J. J. Bouckaert, 274
Belgique, Société Géologique de, Dr. L. J. Spencer elected a corresponding member of the, 190
Bending Wood by Hand, Methods of, 977
Benzanthrones, Synthesis of, F. G. Baddar and F. L. Warren, 321
Benzene-Diazonium Chloride, Decomposition of, Dr. W. A. Waters, 466
Bethlehem : Early Man at, Evidence of, 186 ; Ancient Fauna and Early Man at, 381 ; The Bone-bearing Beds of, their Fauna and Industry, Miss Elinor W. Gardner and Miss Dorothea M. A. Bate, 431 ; *Flaked Flints from the Bone Beds of*, Miss D. A. E. Garrod, 808
Bialowieza National Park, Poland, Census of Game Animals in the, 358
Biélás Comet, Disappearance of, J. Bosler and H. Roure, 40
Binary : Mixtures, Viscosity of, Dr. J. S. Gourlay, 157 ; Orbits, Two Visual, Dr. R. v. d. R. Woolley and L. S. T. *Symms*, 160
Biochemistry : Applied to Malting and Brewing, Prof. R. H. Hopkins and B. Krause (*Review*), 705 ; Annual Review of, Edited by Dr. J. M. Luck. Vol. 6 (*Review*), 745 ; *Progress of* (*Review*), 745
Bioclimatic Zones of Australia, Dr. J. Davidson, 265
Biological : Standards, 555 ; Laboratory Technique : An Introduction to Research in Embryology, Cytology and Histology, Prof. J. B. Gatenby (*Review*), 1081
Biologischen Arbeitsmethoden, Handbuch der, Herausgegeben von Prof. E. Abderhalden. Lief. 460. Abt. V : Teil 10, Heft 6 (*Review*), 218
Biology : General, Systematics in Relation to, 211 ; for Students of Pharmacy, E. J. Moore (*Review*), 633 ; Surface Action in, Prof. E. K. Rideal, 716 ; and the New Physics : a Plea for a Consistent Philosophy of Life, C. J. Bond (*Review*), 953 ; for Medical Students, C. C. Hentschel and Dr. W. R. I. Cook. Second edition (*Review*), 994
Birch 'Forests' of Greenland, The, Dr. N. Polunin, 939
Bird Life (*Review*), 1034 ; Protection in Britain, 1094
Birds" : British, "The Handbook of, H. F. Witherby, 199 ; Speed of Flight of, May Thacher Cooke, 325 ; Wild, and Butterflies, Dr. W. E. Collinge ; Prof. G. D. Hale Carpenter, 974 ; of the Malay Peninsula, late H. C. Robinson and F. N. Chasen. Vol. 3 : Sporting Birds ; Birds of the Shore and Estuaries (*Review*), 1034 ; of the World, Check-List of, J. L. Peters. Vol. 3 (*Review*), 1034 ; The Book of, Edited by Dr. G. Grosvenor and Dr. A. Wetmore. 2 Vols. (*Review*), 1034
Birmingham : Central Technical College, Dr. E. F. Armstrong awarded an honorary associateship of the, 929 ; University : conferment of honorary doctorates on Lord Austin, Sir Harry Gilbert Barling, E. Cadbury, Sir Wilfrid Arthur Greene, Sir Percival Perry, and C. C. Paterson, 80 ; New Chemistry Laboratories, opening address by Sir Frederick Gowland Hopkins, 121 ; conferment of an honorary doctorate on C. C. Paterson, 351 ; Development of, 538 ; resignation of Sir Charles Grant Robertson, 694 ; conferment of an honorary doctorate on the Duke of Kent, 735 ; appointment of Dr. R. E. Priestley as vice-chancellor, 932, 942 ; retirement of G. O. Harrison, 1045 ; conferment of a doctorate on J. L. Shimwell, 1110
Birth Control, Scientific Basis of, Dr. C. V. Drysdale, 19
Bivalve Spatfalls, Hydrography and Fisheries, Some Interrelations between, Prof. J. H. Orton, 505
Blastocladia Pringsheimii, Germination of Resistant Spores of, Miss Elizabeth Blackwell, 933
Blood : Brotherhood in Dahomey, P. Hazomoné, 325 ; Smears, Supra-vital Stained, Method for Fixing Neutral-red in, A. Hjärre and H. Berthelsen, 155 ; Group *A B*, Races with a High Proportion of, Dr. R. Elsdon Dew, 1066
Blow-fly Repellant, A New, H. O. Mönnig, 812
Bodies for Dissection, Preservation of, [1837], 434
Body Size and Metabolism, Relation between, C. Ellenby, 853
Bogs at Ballybetagh, with Remarks on the Development of Late-Glacial Deposits in Ireland, J. Kissen and A. Farrington, 376
Boissons, Les plantes à, Prof. D. Bois (Les plantes alimentaires chez tous les peuples et à travers les ages) (*Review*), 787
Borine Carbonyl, A. B. Burg and H. I. Schlesinger, 74
Boron : in the Potash Salts of Alsace, Presence and Distribution of, G. Bertrand, 820 ; in Agriculture, Miss Katherine Warington, 1016
Bororo, Clan Reciprocity Among the, C. Levi-Strauss, 429
Botanical : Society : of Edinburgh, *Transactions and Proceedings* of the, 32, Part 1, 20 ; [1837], 208
Botany, Medical, Advantages of, [1837], 904
Bovine Congenital Porphyrinuria, Duality of the Coproporphyrins in, Dr. C. Rimington and G. C. S. Roets, 584
Bradley's Zenith Sector Sent to the Cape [1837], 250
Brazil, Caverns in, [1837], 655
Breakers, Interpretation of Observations and Measurements *Relating to*, P. Pétry, 820
Bremsstrahlung, On, J. C. Jaeger, 108
Brisbane Seismological Station, 231
Bristol University, resignation of Dr. E. Ashby, 904
Britain : and the Beast, J. M. Keynes and others (*Review*), 623 ; Land of, Planning the, Dr. L. D. Stamp and others, 791 ; Early, Town Life in, Dr. R. E. Mortimer Wheeler (Norman Lockyer lecture), 924 ; The Hill Lands of, Development or Decay ? Prof. R. G. Stapledon (*Review*), 1031
British : Association : Nottingham meeting of the, 95 ; at Liverpool, [1837], 375 ; 434 ; at Nottingham ; Lord Rayleigh elected president for 1938, 453 ; and the Indian Science Congress : a Scientific Delegation to India, 609 ; Seismological Committee, Report of the, 721 ; and the Indian Science Congress, 921 ; Astronomical Association, presentation of the Walter Goodacre gold medal and gift to Dr. A. C. D. Crommelin, 800 ; Chemical Manufacturers, Activities of the Association of, E. Wallace ; Dr. F. H. Carr elected president, 719 ; Depopulation, The Menace of, Dr. G. F. McCleary (*Review*), 528 ; Empire Cancer Campaign, grants, etc. of the, 103 ; Medical Association, Belfast meeting of the, 186 ; Museum : (Natural History) : Acquisitions at the, 18 ; Dr. F. W. Edwards appointed a deputy keeper in the department of entomology, 61 ; Acquisitions at the, 187 ; Acquisitions, 764 ; (Bloomsbury), Recent Acquisitions, 801 ; (Natural History), Catalogue of Fossil Cirripedia in the Department of Geology. Vol. 2 : Cretaceous, T. H. Withers (*Review*), 873 ; Polar Year Expedition, Fort Rae, N.W. Canada, 1932–33. 2 Vols. (*Review*), 825 ; Rainfall, 1936 (*Review*), 873 ; School of Archæology at Athens, 1935–36, 58 ; Museum : (Natural History), Acquisitions of the, 966 ; (Bloomsbury), Acquisitions at the, 1046 ; (Natural History), C. Forster Cooper appointed director, 967 ; Colonies, Introduction of Plants into, 1055 ; Institute of Radiology : Annual Congress and Exhibition, 1069 ; Archæology, Cultural Successions in, 1109
Brittany, A Mesolithic Site in, 329
Broad Bean *Plants in* Water Culture, Effect of Heteroauxin on the Growth of, Dr. H. L. Pearse, 26
Broadcasting in India, 614
Bronze Age France, The Oolitic Limestone Escarpment in, Miss Margaret Dunlop, 243
Brown-Firth Research Laboratories, Equipment and Work of the, 60
Buenos Aires, Medical Association of Kinesiology, Prof. M. Westenhöfer elected an honorary member of the, 358

Building Materials, Chemistry of, Dr. R. E. Stradling, 607
Burial-Mounds of England, The Ancient, L. V. Grinsell (*Review*), 218
Business: Man's Library, A, *615*; Administration, Training in, 1092
Butterflies: Markings of, Chemical Development of the, W. Häuslmayer, 41; Egg-laying, New Observations on Responses to Colours in, Dora Ilse, 544; Wild Birds and, Dr. W. E. Collinge; Prof. G. D. Hale Carpenter, 974

CO Bands, Structure of a New System of, Dr. R. Schmid and Dr. L. Gerö, 508
Cables for 200,000 Volt Pressures, 927
Cadmium Nitride (Hydrozoate), Structure of, M. Bassière, 125
Calcium: Bicarbonate in the Waters of the River Versoix (Canton of Geneva), Origin of the, J. P. Buffle, 125; Phosphorus and, Deficiency Diseases as Two Etiologically Distinct Entities, Dr. P. J. Du Toit and Dr. A. I. Malan, 153
Calculus, Theory and Practice of the, Dr. A. J. Ward (*Review*), 631
Calcutta: University College of Science, retirement of Sir P. C. Rây; election of Sir P. C. Rây as professor emeritus, 762
California: Sardine and its Fishery, Frances N. Clark, *858*; Northern, *Earthquakes off the Coast of*, Prof. Byerly, 937
Calomel Vapour, Nature of, F. T. Gucker, jun., and R. H. Munch, 648
Cambridge: Philosophical Society, election of officers, 888; University: Dr. H. J. Bhabha awarded an 1851 exhibition studentship; Dr. C. F. A. Pantin *to be appointed reader in invertebrate zoology*; Dr. R. D. Davies elected a research fellow of Christ's College; Sir David Chadwick elected an honorary fellow of Sidney Sussex College, 38, 80; Dr. A. D. Thackeray appointed assistant director of the Solar Physics Observatory, 80; Dr. O. M. B. Bulman appointed lecturer in palæozoology, Dr. J. K. S. St. Joseph demonstrator in geology, M. Black demonstrator in geology, J. D. Boyd lecturer in anatomy, Dr. W. A. H. Rushton lecturer in physiology, S. J. R. Reynolds and C. D. P. Jones demonstrators in anatomy, A. L. Hodgkin demonstrator in physiology, and Dr. G. N. Myers demonstrator in pharmacology, 123; A. M. Barry appointed a Frank Edward Elmore student, and B. G. Wilkinson and M. G. M. Pryor awarded Frank Smart prizes, 123; Early Science in, Dr. R. T. Gunther (*Review*), 130; Dr. J. H. Schulman appointed assistant director of research in colloid science; D. J. Bauer elected Michael Foster student in physiology; award of the E. G. Fearnsides scholarship to A. M. Barry, the Wrenbury scholarship to P. T. Bauer, and the John Winbolt prize to D. W. Ginns, 291; K. P. Harrison and O. L. Kangwill awarded Harold Fry studentships at King's College; J. V. Dunworth and T. E. Easterfield awarded Denman Baynes research studentships at Clare College; A. G. Ward awarded an external research studentship at Emmanuel College, 435; T. R. C. Fox and J. Diamond appointed demonstrators in engin*eering*; Dr. R. A. Lyttleton and M. H. L. Price appointed faculty assistant lecturer in mathematics; J. Hart-Mercer elected Gwynaeth Pretty student and Nita King scholar; R. E. B. Makinson awarded a Strathcona exhibition for physics at St. John's College, and J. H. Sang a Hutchinson studentship for zoology, 476; G. Metcalfe appointed Frank Smart student in botany; G. S. Gough, C. H. Bamford and D. M. A. Leggett elected fellows of Trinity College; bequest by W. C. Wilson, 735; R. L. M. Synge appointed Benn W. Levy student in biochemistry; grants from the Balfour Fund; conferment of a degree on Prof. T. Dalling, 778; Dr. H. Brück appointed first junior observer in the Solar Physics Observatory; Miss M. L. Tomlinson elected a staff fellow of Girton College, 819; gifts from J. W. O. Hamilton for radio research, 862; portraits of Sir Albert Seward and Dr. F. F. Blackman presented to the Botany School, 845; G. L. Clark elected an Isaac Newton student; Dr. C. F. A. Pantin appointed reader in invertebrate zoology, T. T. Paterson curator of the Museum of Archæology and of Ethnology, Dr. J. A. Ramsay, Harding lecturer in experimental zoology, Dr. G. S. Carter, F. R. Parington and Dr. G. Salt lecturers in zoology, 904; Prof. E. Cartan appointed Rouse Ball lecturer for 1937–38; Prof. M. Siegbahn appointed Scott lecturer for 1938–39; gift for the Experimental Zoology Fund; H. C. Gilson and Dr. S. Smith appointed demonstrators in zoology and Prof. S. Chapman a member of the Committee for Geodesy and Geophysics, 1026; conferment of a doctorate on W. G. Palmer, 1110
Cambium Tissue, Culture of, R. Gautheret, 905
Canada: Engineering Institute of, election as honorary members of Sir Alexander Gibb, Hon. C. D. Howe, Hon. G. Stirling, Prof. R. W. Angus, Dr. G. H. Duggan, and S. J. Hungerford, 274; Royal Society of, Annual Meeting; award of the Flavelle medal to Dr. F. D. Adams, the Lorne Pierce medal to Prof. S. Leacock, and the Tyrrell medal to A. Fauteux; Prof. A. G. Huntsman elected president for 1937–38, 287; Mining Industry of, C. Camsell, 542; Petroleum Fuels in, 978
Canadian Shield, Gold Deposits of the, E. L. Bruce, 116
Cancer: Memorandum on Provision of Radio-Therapeutic Departments in General Hospitals, Lt.-Col. Smallman, 356
Candle, Death in the, [1837], 39
Cannizzaro Reaction: Catalysis of the, by Active Nickel and Platinum, M. Delépine and A. Horeau, 208; Bonhoeffer and Fredenhagen, 369
Canoes of Polynesia, Fiji and Micronesia, J. Hornell, 510
Cape Town University, Prof. A. W. Falconer appointed principal and vice-chancellor, 476
Car Maintenance and Repair, A. W. Judge. Second edition (*Review*), 704
Carbohydrates *in vitro*, Photosynthesis of, Prof. E. C. C. Baly, 930
Carbon: Monoxide, Hydrogen and Oxygen, Heterogeneous Combustion of Mixtures of, on a Vitreous Surface, M. Prettre, 251; -Carbon Bond Distances, L. Pauling and L. O. Brockway, 688; Dioxide, Vibrational Energy of, Determination of the Relaxation Time for the, Prof. A. van Itterbeek and P. Mariëns, 850; Disulphide, Infra-red Absorption of, C. R. Bailey, 851; Suboxide, Structure of, Dr. R. C. Lord and Dr. A. Wright, 856; Atomic Weight of, A. F. Scott and F. H. Hurley, 1068; Monoxide Mixtures, Influence of Hydrogen and Water Vapour upon the Combustion of, Prof. W. T. David and B. Pugh, 1098
Carborundum, Ultra-filters of, J. Duclaux and M. Amat, 658
Carcinogenic Agents, Photodynamic Action of, Dr. J. C. Mottram and Dr. I. Doniach, 933
Caribbean Sea, Cyclone Series in the, October 17–24, 1935, E. Kidson, 286
Carlsberg Ridge, Basalts from the, Dr. J. D. H. Wiseman, 855
Carnegie: Institution of Washington, Report for year ending October 31, 1936, 247; United Kingdom Trust, Report for 1936, 541; Catalogue of Publications of the, 1094
Carotenoids and other Lipoid-soluble Pigments in the Sea and in Deep Marine Mud, D. L. Fox, 519
Cartesian Diver, Principle of the, Applied to Gasometric Technique, Dr. K. Linderstrøm-Lang, 108
Cartography, 460
Caspian Sea, Level of the, [1837], 942
Catalytic: Action of Surfaces, The, Dr. J. E. Nyrop. Second edition (*Review*), 827; Reactions, Dr. H. W. Melville (*Review*), 827
Catechol Ethers, Derivatives of Higher, G. K. Hughes and F. Lions, 695

Caterpillar Plagues in Great Britain, Recent, 94

Catgut for Surgical Use, Safe, 1094

Cathode: Sputtering, Controlled, Dr. G. Timoshenko, 67; Ray Tube: The Low Voltage, and its Applications, G. Parr (*Review*), 1032

Caves and Caving, No. 1, 186

Cell: Walls, Lignified, Histochemical Study of, J. Kisser and K. Lohwag, 335; Division, Radiation and, Tansley, Spear and Glücksmann, 686; Nucleus and Cytoplasm, Interaction between, Prof. C. Stern, 770; Dr. C. D. Darlington, 932

Cells, Respiring, Prevention of Assimilation in, Dr. C. E. Clifton, 318

Cellulose: Hydrate, Transformation of, into Native Cellulose, Prof. K. H. Meyer and N. P. Badenhuizen, jun., 281; Starch and Glycogen, Prof. H. Staudinger, 1071

Cementite, Pure, Isolation of, by Acid Attack of Ferrous Materials and on Some Physical Properties of this Body, A. Travers and R. Diebold, 1073

Cements, Hydraulic, Dr. F. M. Lea, 899

Central: Nervous System, Choline Esterase in the, D. Nachmansohn, 427; (Native) Medical School, Suva, Fiji, The, Sir James Barrett, 472

Cepheid Variables, Maintenance of the Pulsation in, Dr. J. Woltjer, jun., 195

Cereal Crosses, Reciprocal, Endosperm and Embryo in, J. W. Boyes and W. P. Thompson, 511

Charcoal, Activated, Adsorption of Gases and Vapours on, R. Juza and Langheim, 649

Chatham House, Prof. A. G. B. Fisher appointed Price professor of international economics at, 143

Chemical: Industry: Society of, Food Group, 20; Science, A Retrospect of, Prof. G. G. Henderson, 145; Society of Stockholm, award of the Scheele medal to Dr. A. Butenandt, 274; Reactions: Retardation of, Prof. K. C. Bailey and G. T. Taylor, 327; The Retardation of, Prof. K. C. Bailey (*Review*), 340; Stabilization, Prof. N. R. Dhar (*Review*), 340; Anniversaries, Daily, As a Teaching Tool, E. H. Huntress, 616; Engineering Congress of the World Power Conference, Transactions of the. 5 Vols. (*Review*), 627; Engineering: Position and Prospects (*Review*), 627; Principles, with Particular Application to Qualitative Analysis, Prof. J. H. Yoe (*Review*), 634; Industry: French Society of, Seventeenth Congress in Paris, 672; Research, Dr. I. Langmuir, 901; Changes and Chances, Sir Martin Forster (Streatfeild memorial lecture), 1055; Encyclopædia, A (*Review*), 1076

Chemicals in War: a Treatise on Chemical Warfare, Dr. A. M. Prentiss. With chapters on the protection of Civil Populations and International Situation, by Major G. J. B. Fisher (*Review*), 3

Chemie: Lehrbuch der, Prof. W. Hückel. Teil 2. Organische Chemie (*Review*), 868; Anorganischen, Handbuch der, Herausgegeben von Prof. R. Abegg, Dr. F. Auerbach und Dr. I. Koppel. Band 4. Abt. 3. Teil 4, Lief 1, Herausgegeben von Dr. I. Koppel (*Review*), 1081

Chemistry: Progress of, Annual Reports on the, for 1936. Vol. 33 (*Review*), 7; Applied, Reports of the Progress of, Vol. 21, 1936 (*Review*), 49; of Indian Opium, Dr. H. B. Dunnicliff, 92; Elementary, and its Presentation, Prof. C. S. Gibson (*Review*), 173; New Practical, Fundamental Principles Applied to Modern Life, Prof. N. H. Black and J. B. Conant (*Review*), 173; Practical, New Laboratory Experiments in, Prof. N. H. Black (*Review*), 173; A Brief Outline of its History and Development, A. Barclay, 232; for Everyman, Prof. A. Findlay (*Review*), 300; Matter and Life, Dr. S. Miall and L. M. Miall (*Review*), 300; Inorganic, A Text-book of, Edited by Dr. J. Newton Friend. Vol. XI, Part 4, by A. E. Goddard (*Review*), 528; of Building Materials, Dr. R. E. Stradling and others, 607; A Hundred Years of, Prof. A. Findlay (*Review*), 624; Modern, The Growth of, Prof. J. Read (*Review*), 624; Organic, Practical, A. J. Mee (*Review*), 634; Quantitative Pharmaceutical, Prof. G. L. Jenkins and Prof. A. G. Du Mez. Second edition (*Review*), 634; The Drama of, How Man Deals with Atoms, Prof. S. J. French (*Review*), 634; of Natural Products Related to Phenanthrene, The, Prof. L. F. Fieser. Second edition (*Review*), 704; Mineral, and Crystal Structure, Prof. P. Niggli (*Review*), 783; Organic: A Survey of, Prof. C. S. Gibson (*Review*), 868; Synthetic, Recent Progress in, Dr. G. O. Curme, jun., 901; Intermediate, late Prof. T. M. Lowry and A. C. Cavell; Prof. H. V. A. Briscoe (*Review*), 910; Enzyme, Dr. H. Tauber (*Review*), 948; in the Ancient World, Prof. J. R. Partington (Bedson lecture), 1006; Applied, Thorpe's Dictionary of, Prof. J. F. Thorpe and Dr. M. A. Whiteley. Fourth edition. Vol 1 (*Review*), 1076

Chemotherapy, Researches in, Dr. F. L. Pyman, 409

Cherries, Sweet, Incompatibility and Sterility in, M. B. Crane and A. G. Brown, 1019

Cherry Trees, Bacteriosis of, H. Wormald, 285

Cheshunt Research Station, Annual Report for 1936, 860

Chicken Retina: Carotenoids of the, G. Wald and H. Zussman, 197; Photo-labile Pigments of the, Dr. G. Wald, 545

Chickens, Hatching Weight of, Factors Affecting, N. Galpin, 1027

Chile, Ancient Man in, 538

China: Medical Mission to, [1837], 598; European Botanical Discoveries in, History of, F. C. Stern, 1093

Chinese: Ceramic Glazes, A. L. Hetherington (*Review*), 382; Bronzes, Early, R. S. Jenyns, 591; Centres of Learning, Destruction of, 925

Chirocephalus (The Term "Gnathobase" Lankester), A. G. Lowndes, 33

Chlorates, Bromates and Iodates, Characteristic Frequencies of, M. Parodi, 943

Chlorophyll, Reversible Bleaching of, D. Porret and Dr. E. Rabinowitch, 321

Chloroplast Pigments in Leaves during Senescence, Changes in, Prof. B. N. Singh and N. K. A. Rao, 728

Chlorous Anhydride, Existence of, Dr. C. F. Goodeve and F. D. Richardson, 737

Cholera: in Europe, [1837], 477; in Africa, [1837], 862

Cholesterol and Dehydroandrosterone, Oxidation of, by Means of Osmic Acid, Prof. M. Ushakov and A. Lutenberg, 466

Choline Esterase: Activity of Superior Cervical Ganglia, D. Glick, 426; in the Central Nervous System, D. Nachmansohn, 427

Christianson Filters, G. Ahier, 477

Chromatographische Adsorptions-methode: Die, Grundlagen, Methodik, Anwendungen, Prof. L. Zechmeister und Dr. L. v. Cholnoky (*Review*), 48

Chromium Hydride, CrH., Band Spectrum of, A. G. Gaydon and Dr. R. W. B. Pearse, 110

Chromosomes: in Mitosis, Effect of X-Rays on, A. Marshak, 779; Double Structure of, Prof. R. R. Gates, 1013

Chronica Botanica, Changes in, 967

Chrysanthemum, Florist's Effect of Spraying Solutions of Growth Substances on the Inflorescences of the, L. G. G. Warne, 1065

Chuchuhuasha, Botanical Origin of the, Raymond-Hamet and Colas, 334

Cist Burial at Blaydon-on-Tyne, 272

Citizenship, 43

Citrus: Diseases and their Control, Prof. H. S. Fawcett. Second edition (*Review*), 526; Manuring, F. G. Anderssen, 976

Civil: List Pensions, Grants of, 104; Engineers, Institution of, awards of the, 722; *Engineer and Architect's Journal*, [1837], 777; Engineering at the University of Durham, [1837], 904; Engineers, Institution of, E. Graham Clark appointed secretary of the, 1058; List Pensions, Debate on, [1837], 1072

Civilization and the Hittites, Origins of, Prof. E. Pittard, 677

Climatic Cycles and Tree Growth, W. S. Glock, 855

Clock Time-marker, A Synchronous, J. H. J. Poole, 376

Cloeon dipterum, Function of the Gills of the Mayfly Nymph, C. A. Wingfield, 27
Coal: Dust, Fine, Spontaneous Electrical Charge of, Dr. S. C. Blacktin, 280; Gas, Extinguishing Flames by, Behaviour of Cylinders of Inflammable Gas in a Fire: Prof. K. C. Bailey, 503; Measure Rocks, Part 1, H. M. Hudspeth and D. W. Phillips, 813; Carbonization of, at Low Temperatures, 937
Cobalt: and Sheep Diseases, J. B. E. Patterson, 363; Hydroxides, C. Duval, 985
Coffee Plants, Chromosomes of, Dr. C. A. Krug, 429
Colchicine: 'Phytocarcinomata' and Plant Hormones, L. Havas, 191; Mechanism of Polyploidy through, B. R. Nebel, 1101
Colliery Winding Ropes, Internal Corrosion in, Effect of Fibre Cores on, J. E. O. Mayne, 818
Colonial: Office appointments, 104; 315; 460; 680; 845; 1058; Problem, A Scientific Approach to the, 739
Color Sense Examination, Polychromatic Plates for, Dr. E. B. Rabkin (*Review*), 49
Coloration, Attitude and Concealing, J. J. S. Cornes; Prof. G. D. Hale Carpenter, 684
Colour: Defects, Tests for, Dr. Mary Collins, 414; 532; 569
Colours, Discriminable, The Number of, Dr. G. B. Welch, 28
Combustible Substances, Regarded as Helping Incombustible Extinguishers, for the Practical Extinction of Flames, C. Dufraisse and J. Le Bras, 905
Comet: A New (1937 *f*), 103; Finsler, 273; 1937 *g* (Hubble), New, 315
Comets: Preliminary General Catalogue of, 357; their Nature, Origin and Place in the Science of Astronomy, Mary Proctor and Dr. A. C. D. Crommelin (*Review*), 566; and Problems of Cosmogony, Rev. Dr. M. Davidson, 799
Common Sense: Science and, an Aristotelian Excursion, Dr. W. R. Thompson (*Review*), 872
Community, Science and the, J. Ramsay MacDonald (Radford Mather lecture), 756
Compton Manor Estate as a Veterinary Field Station, 718
Conditioned Reflexes and Psychology, Prof. J. H. Gaddum (*Review*), 700
Conifers of Quebec Province, Distribution of Manganese and Iron in the, P. Riou, G. Delorme and H. Gamelin, 1027
Connecticut, Amphibia of, 686
Connexion Projective, Leçons sur la théorie des espaces à, Prof. E. Cartan (*Review*), 950
Co-operation, International, in Science, 337
Copepod Development, Variations in, Dr. S. G. Gibbons, 1064
Copepods, Scottish, Dr. S. G. Gibbons, 116
Copley medals, award of two, [1837], 941
Copper: Reflecting Power of, L. Capdecomme and P. Jacquet, 40; Conductors, Electrical and Mechanical Ageing of, under the Prolonged Action of the Electric Current, O. Yadoff, 251; Potassium, Double Sulphate of, Dehydration of the, Mme. Nathalie Demassieux and B. Federoff, 778
Cornwall, Erosion Surfaces of, W. G. V. Balchin, 326
Corona: The, by Reflection from the Moon, Dr. A. V. Douglas, 156; The Globular, 577
Coronal Emission Lines Observed at the Total Solar Eclipse of June 19, 1936, Prof. R. Sekiguti, 724; Prof. F. J. M. Stratton, 725
Coronation: Ceremonial (*Review*), 5; English, A History of the, Prof. P. E. Schramm. Translated by L. G. W. Legg (*Review*), 5

CORRESPONDENCE

α-Amino-Acids, Absolute Configuration of the Naturally Occurring, R. C. Rainey, 150
α-Phellandrene, Conversion of β-Phellandrene into a Derivative of, Dr. N. F. Goodway and T. F. West, 934
Acetanilides, 2 : 6-Disubstituted, Evidence of Restricted Rotation about the N—C Bond in, Dr. L. Hunter and H. O. Chaplin, 896
Acidosis and Off-flavoured Milk, Capt. H. Barkworth and L. W. L. Cole, 324
Agriculture, Boron in, Miss Katherine Warington, 1016
Aldehydes and Ketones, Photo-decomposition of, Prof. R. G. W. Norrish and C. H. Bamford, 195
Alkyl Ethers, Nitric Oxide and, Prof. M. W. Travers, 107; Halides, Series Effect on the Dipole Moments of Some, E. G. Cowley and Prof. J. R. Partington, 1100
Alloys, Iron-Nickel-Aluminium, High Coercivity in, an X-Ray Investigation of the Cause of, Dr. A. J. Bradley and A. Taylor, 1012
Aluminium, Nuclear Moments of, D. A. Jackson and Dr. H. Kuhn, 110
Amino-Acids: α, Absolute Configuration of the Naturally Occurring, R. C. Rainey, 150; Formation and Breakdown of, by Intermolecular Transfer of the Amino Group, Prof. A. E. Braunstein and M. G. Kritzmann, 503
Amphibian Anterior Pituitary, Gonadotropic Activity of, Dr. H. Zwarenstein, 588
Androgenic Endocrine Activity in the Female Mammal, Prof. A. Lipschütz, 892
Anopheles gambiæ Giles, A Cage Colony of, B. De Meillon, 428
Anuran Gastrula, Ectoderm of the, Neural Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the, Prof. G. A. Schmidt, 199
Aromatic Compounds, Antimicrobial Action of Some, Dr. A. Girard, A. Ray and G. Richard, 283
Arsine, Phosphine and, Derivatives of the Group I (*b*) Metals: Volatile Derivatives of Gold, Dr. F. G. Mann and A. F. Wells, 502
Ascorbic Acid: in Fermented Products, Estimation of, Specificity of Indophenol in the, F. W. Fox and W. Stone, 234; from Urine, Isolation of, Dr. C. P. Stewart, H. Scarborough and Dr. P. J. Drumm, 282
Atmospheric Pressure at High Altitudes, Spectrum of Nitrogen and, R. Bernard, 930
Atomic Constitution, Interpretations of, Lt.-Col. J. T. C. Moore-Brabazon, 893; 971; Prof. E. N. da C. Andrade, 894; Prof. A. S. Eve, 1061
Aurora Rays, Divided, with One Part in the Sunlit and another in the Dark Atmosphere, Prof. C. Störmer, 1095
Aurous Compounds: Constitution of, Gold Mirrors, Prof. C. S. Gibson, 583
Australopithecus, Discovery of a Lower Molar of, Dr. R. Broom, 681
Auxin, Action of, on Protoplasmic Streaming, Prof. K. V. Thimann and Miss Beatrice M. Sweeney, 807
Axial: Magnetic Suspension, Frictional Torque of an, Dr. F. T. Holmes and Prof. J. W. Beams, 30; Spin and Weapons of the Ancients, L. J. D. Richardson, 1016
Azobenzene, The *Cis*-form of, G. S. Hartley, 281
β-Boswellinic Acid, Structure of, Dr. J. C. E. Simpson, 467
β-Decay as Due to a Neutrino Shower, N. S. Nagendra Nath, 278
β-Phellandrene, Conversion of, into a Derivative of α-Phellandrene, Dr. N. F. Goodway and T. F. West, 934
Band Spectra, Vibration Temperature in Relation to Rotation Temperature in, Dr. N. R. Tawde and S. A. Trivedi, 463
Barium, Surface Migration of, Dr. M. Benjamin and R. O. Jenkins, 152
Benzanthrones, Synthesis of, F. G. Baddar and F. L. Warren, 321
Benzene-Diazonium Chloride, Decomposition of, Dr. W. A. Waters, 466
Bethlehem, Bone Beds of, Flaked Flints from the, Miss D. A. E. Garrod, 808
Binary Mixtures, Viscosity of, Dr. J. S. Gourley, 157
Birds": British, "The Handbook of, H. F. Witherby, 199; Wild, and Butterflies, Dr. W. E. Collinge; Prof. G. D. Hale Carpenter, 974
Bivalve Spatfalls, Hydrography and Fisheries, Some Interrelations between, Prof. J. H. Orton, 505

Blastocladia Pringsheimii**, Germination of Resistant Spores of, Miss Elizabeth Blackwell, 933**
Blood: **Smears**, Stained, Method for Fixing Neutral-red in Supra-vital, A. Hjärre and H. Barthelson, 155; Group *A B*, Races with a High Proportion of, Dr. R. E. Dew, 1066
Body Size and Metabolism, Relation between, E. Ellenby, 853
Boron in Agriculture, Miss Katherine Warington, 1016
Bovine Congenital Porphyrinuria, Duality of the Copro-porphyrins in, Dr. C. Rimington and G. C. S. Roets, 584
Bremsstrahlung, On, J. C. Jaeger, 108
Broad Bean Plants, Effect of Hetero-auxin on the Growth of, in Water Culture, Dr. H. L. Pearse, 26
Butterflies: Egg-laying, New Observations on Responses to Colours in, Dora Ilse, 544; Wild Birds and, Dr. W. E. Collinge; Prof. G. D. Hale Carpenter, 974
CO Bands, Structure of a New System of, Dr. R. Schmid and Dr. L. Gerö, 508
Calcium, Phosphorus and, Deficiency Diseases as Two Etiologically Distinct Entities, Dr. P. J. Du Toit and Dr. A. I. Malan, 153
Carbohydrates *in vitro*, Photosynthesis of, Prof. E. C. C. Baly, 930
Carbon: Dioxide, Vibrational Energy of, Determination of the Relaxation Time for the, Prof. A. van Itterbeek and P. Mariëns, 850; Disulphide, Infra-red Absorption of, C. R. Bailey, 851; Monoxide Mixtures, Influence of Hydrogen and Water Vapour upon the Combustion of, Prof. W. T. David and B. Pugh, 1098
Carcinogenic Agents, Photodynamic Action of, Dr. J. C. Mottram and Dr. I. Doniach, 933
Cartesian Diver, Principle of the, Applied to Gasometric Technique, Dr. K. Linderstrøm-Lang, 108
Cathode Sputtering, Controlled, Dr. G. Timoshenko, 67
Cell: Nucleus and Cytoplasm, Interaction between, Prof. C. Stern, 770; Nucleus and Cytoplasm, Interaction between, Dr. C. D. Darlington, 932
Cells, Respiring, Prevention of Assimilation in, Dr. C. E. Clifton, 318
Cellulose, Hydrate, Transformation of, into Native Cellulose, Prof. K. H. Meyer and N. P. Badenhuizen, jun., 281
Central Nervous System, Choline Esterase in the, D. Nachmansohn, 427
Cepheid Variables, Pulsation in, Maintenance of the, Dr. J. Woltjer, jun., 195
Chicken Retina: Carotenoids of the, G. Wald and H. Zussman, 197; Photo-labile Pigments of the, Dr. G. Wald, 545
Chlorophyll, Reversible Bleaching of, D. Porret and Dr. E. Rabinowitch, 321
Chloroplast Pigments in Leaves during Senescence, Changes in, Prof. B. N. Singh and N. K. Anantha Rao, 728
Cholesterol and Dehydroandrosterone, Oxidation of, by Means of Osmic Acid, Prof. M. Ushakov and A. Lutenberg, 466
Choline Esterase: Activity of Superior Cervical Ganglia, D. Glick, 426; in the Central Nervous System, D. Nachmansohn, 427
Chromium Hydride, CrH, Band Spectrum of, A. G. Gaydon and Dr. R. W. B. Pearse, 110
Chromosomes, Double Structure of, Prof. R. R. Gates, 1013
Chrysanthemum, Inflorescences of the Florists', Effect of Spraying Solutions of Growth Substances on the, L. G. G. Warne, 1065
Cloeon dipterum, Function of the Gills of the Mayfly Nymph, C. A. Wingfield, 27
Coal: Dust, Fine, Spontaneous Electrical Charge of, Dr. S. C. Blacktin, 280; Gas, Extinguishing Flames by, Behaviour of Cylinders of Inflammable Gas in a Fire: Prof. K. C. Bailey, 503
Cobalt, and Sheep Diseases, J. B. E. Patterson, 363
Colchicine, 'Phytocarcinomata' and Plant Hormones, L. Havas, 191; Mechanism of Polyploidy through, B. R. Nebel, 1101
Coloration, Concealing, Attitude and, J. J. S. Cornes; Prof. G. D. Hale Carpenter, 684
Colours, Discriminable, The Number of, Dr. G. B. Welch, 28
Copepod Development, Variations in, Dr. S. G. Gibbons, 1064
Corona, The, By Reflection from the Moon, Dr. A. V. Douglas, 156
Coronal Emission Lines Observed at the Total Solar Eclipse of June 19, 1936, Prof. R. Sekiguti, 724; Prof. F. J. M. Stratton, 725
Cosmic: Radiation, Longitude Effect and the Asymmetry of, Prof. G. Lemaître, 23; Ray Measurements, Use of Krypton-filled Ionization Chambers for, Dr. S. Ziemecki, 150; Radiation, Absorption of the Soft Component of, Dr. W. Heitler, 235; Rays, Expulsion of Neutrons from Lead by, B. Arakatsu, K. Kimura and Y. Uemura, 277; Ray Intensity, World-wide Effect in, as Observed During a Recent Magnetic Storm, Prof. V. F. Hess and A. Demmelmair, 316; Rays and Magnetic Storms, Prof. S. Chapman, 423; Ray Intensity during Magnetic Storms, Variations of, Prof. C. Störmer, 549; Rays, Disintegration Processes by, with the Simultaneous Emission of Several Heavy Particles, M. Blau and H. Wambacher, 585; Ray Burst, A, at a Depth Equivalent to 800 m. of Water, Dr. Y. Nishini and C. Ishii, 774; Rays, Abnormal Zenithal Distribution of, M. G. E. Cosyns, 931
Cottons, Wild and Cultivated American, Homologous Loci in, Dr. S. C. Harland, 467
Coulter Compound, The, Lactoflavin, 'Cytochrome *b*', and Cytochrome *c*, Spectroscopic Observations of Reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
Cozymase in Invertebrate Muscle, Dr. S. Ochoa and C. G. Ochoa, 1097
Crystals: with Vitamin K Potency, H. J. Almquist, 25; Organic, Magnetic Anisotropy of, Temperature Variation of, P. Nilakantan, 29; Artificial Slip Formation in, A. W. Stepanow, 64; Volume-Rectification of, B. K. Sen, 1102
Crustacea, Body Orientation in, A. G. Lowndes, 241
Csonka-Straub, Specificity of the Salicylic Aldehyde, Reaction of, Prof. A. E. Braunstein, 427
Cu and Fe, Intensity and Structure Changes of the *L* α Emission Lines of, on Intense Cooling of their Anti-cathodes, Prof. K. Prosad and A. T. Maitra, 464
$CuSO_4 \cdot 5H_2O$, Crystal Structure and the Magnetic Anisotropy of, Prof. K. S. Krishnan and A. Mookherji, 896
Cyclotron, Rays Produced by a, Biological Effects of the, Prof. M. Nakaidzumi, K. Murati and Y. Yamamura, 359
'Cytochrome: *b*', Lactoflavin, the Coulter Compound, and Cytochrome *c*, Spectroscopic Observations of Reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
Cytoplasm: Cell Nucleus and, Interaction between, Prof. C. Stern, 770; Dr. C. D. Darlington, 932
Dead Sea, Œstrogenic Substances in the, Prof. B. Zondek, 240
Dehydroandrosterone, Cholesterol and, Oxidation of, by Means of Osmic Acid, Prof. M. Ushakov and A. Lutenberg, 466
Deuterium, Heterogeneous Equilibria with, Prof. J. R. Partington and R. P. Towndrow, 156
Deuteroethylenes, Raman Spectra of, Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse, 323
Diene Synthesis, A, Applicable to the Sterol Group, A. B. Meggy and Prof. R. Robinson, 282
Diffraction Gratings and Replicas, Recent Improvements in, Prof. R. W. Wood, 723
Diketopiperazine and Tetramethyldiketopiperazine, Infra-red Spectrum and Molecular Structure of, Dr. L. Kellner, 193
Drosophila: Spontaneous Chromatin Rearrangements in, Prof. R. Goldschmidt, 767; Gene Doublets as Evidence for Adjacent Small Duplications in, Dr. H. Grüneberg, 932
Duckweed (*Lemna*), Concentration of Mesothorium-I by, Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunasheva, 317
Dust Control in Industry, J. D. Leitch and L. B. Leppard, 772; Prof. H. V. A. Briscoe, 773

Egyptian Music, Modern, Modes in, M. Mokhtar and Dr. A. M. Mosharrafa, 548
Electrodeless High-frequency Discharge, Effect of a Magnetic Field on the, E. W. B. Gill, 1061
Electrolytes, Strong, Surface Tension of, Prof. M. Dole, 464
Electron: Positron and, Pairs, Production of, by Bombardment of Mercury with β-Particles of Low Energy, Dr. F. C. Champion and A. Barber, 105; Diffraction Studies of Oxides Formed on Iron, T. Iimori, 278
Electronic Charge, Determination of, by the Oil Drop Method, Y. Ishida, I. Fukushima and T. Suetsugu, 29
Electrons: Nuclear Absorption of, Measurement of the, by the Atmosphere up to about 10^{10} Electron-Volts, Prof. I. S. Bowen, Prof. R. A. Millikan and Dr. H. V. Neher, 23; Orbital, Capture of, F. Hoyle, 235
Element 43, Radioactive Isotopes of, C. Perrier and Prof. E. Segrè, 193
Enol-Esters of Testosterone, The Effect of, Dr. K. Miescher, W. H. Fischer and E. Tschopp, 726
Ethyl-chlorophyllide, Elementary Cell and Space Group of, Dr. J. A. A. Ketelaar and E. A. Hanson, 196
Ethylene: Bromide, Thermal Decomposition of, Dr. T. Iredale and A. Maccoll, 24; Hydrocarbon Derivatives of, Œstrogenic Activity of Some, Prof. E. C. Dodds, M. E. H. Fitzgerald and W. Lawson, 772
Experiment, The Function of, Dr. E. C. Childs, 852
Fe-C, System, A New Equilibrium Diagram for the, Dr. I. Iitaka, 462
Fe, Cu and, Intensity and Structure Changes of the $L\ \alpha$ Emission Lines of, on Intense cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464
Ferricyanide, Specific Action of, on Ærobic Glycolysis of Tumour Cells, Dr. B. Mendel and Miss F. Strelitz, 771
Fish: Liver Oils, Freshwater and Marine, Differences in the Chromogenic Properties of, A. E. Gillam, Prof. I. M. Heilbron, Dr. E. Lederer, and V. Rosanova, 233; Freshwater, Blindness in, Dr. W. Rushton, 1014
Force Constants and Molecular Structure, Dr. H. W. Thompson and J. W. Linnett, 1065
Free Radicals in Solution, Dr. D. H. Hey and Dr. W. A. Waters, 934
Frog's Eye, Electrical Response of the, Absorption Curve for Visual Purple and the, Prof. R. Granit, 972
γ-Rays of Polonium, The, H. C. Webster, 852
Galileo and Mathematical Demonstration, W. C. Fahie; G. J. Whitrow, 646
Ganglia, Superior Cervical, Choline Esterase Activity of, D. Glick, 426
Gases: Imperfect, The Cluster Theory of, Dr. C. F. Goodeve, 424; Rare, Chemical Properties of the, B. A. Nikitin, 643
Gasometric Technique, Principle of the Cartesian Diver Applied to, Dr. K. Linderstrøm-Lang, 108
Gene Linkage, Transitive Interference in, Prof. K. de Kőrösy, 322
Genetics, The Position of, Prof. J. B. S. Haldane, 428
Glass Electrode, Mechanism of the, G. Haugaard, 66
Glucolysis, Embryonic, Glyceraldehyde and, Dr. J. Needham and H. Lehmann, 198
Glyceraldehyde and Embryonic Glucolysis, Dr. J. Needham and H. Lehmann, 198
Glycerophosphoric Dehydrogenase, Dr. H. Weil-Malherbe, 725
Glycolysis in Muscle Extracts, The Initial Stages of, Dr. L. P. Kendal and Dr. L. H. Stickland, 360
Gold: Films, Thin, Production of, Prof. C. S. Gibson, 279; Volatile Derivatives of, Phosphine and Arsine Derivatives of the Group I (*b*) Metals: Drs. F. G. Mann and A. F. Wells, 502; Mirrors, Constitution of Aurous Compounds, Prof. C. S. Gibson, 583
Graphite, Colloidal, An Effect of X-Radiation on the ζ Potential of, Prof. J. A. Crowther and H. Liebmann, 28
Gravitational Statics in Three Dimensions, S. G. Emslie, 729
Hæmocyanin Molecule, Splitting of the, by Ultra-sonic Waves, S. Brohult, 805
Haloes, Pleochroic, Some New Types of, Prof. G. H. Henderson, 191
He, Li^{+} and, Ionization Energy of, H. A. S. Eriksson, 151
Heat of Reaction, the Sign and Symbol of, Dr. H. J. S. Sand, 809
Heavy Water, Adiabatic and Isothermal Compressibilities of, Prof. S. Bhagavantam and B. Sundara Rama Rao, 1099
Helium: Liquid, Heat Conduction in, Dr. J. F. Allen, Dr. R. Peierls and M. Zaki Uddin, 62; I and II, Refractive Indexes of, Prof. E. F. Burton, 1015
Hetero-auxin, Effect of, on the Growth of Broad Bean Plants in Water Culture, Dr. H. L. Pearse, 26
Heteroauxones, Role of, in Legume Nodule Formation, Beneficial Effects of Nodules, and Soil Fertility, Prof. G. K. K. Link, 507
High-frequency Fields, Alleged Specific Effects of, on Biological Substances, Dr. J. B. Bateman, Dr. H. Loewenthal and Dr. H. Rosenberg, 1063
Hippolyte varians, Colour Changes in, Dr. L. H. Kleinholz and Dr. J. H. Welsh, 851
Hydrogen: Hα of, Structure of, Prof. N. A. Kent, Royal M. Frye and W. H. Robinson, 236; Bridges in Solid Pentaerythritol, I. Nitta and T. Watanabé, 365
Hyperbolic Space, Dr. G. C. McVittie, 773
Hypothesis, Judgment by, Dr. H. Dingle, 589
Indian Diets, Some, Nutritional Value of, D. N. Mullick and Dr. J. T. Irving, 319
Indophenol, Specificity of, in the estimation of Ascorbic Acid in Fermented Products, F. W. Fox and W. Stone, 234
Inflammable Gas in a Fire, Behaviour of Cylinders of, Dr. O. C. de C. Ellis, 935
Insects, Present-day, Ancestors of some groups of the, Prof. G. Zalessky, 847
Insulin, The Two Crystalline Modifications of, Dr. D. Crowfoot, 149
Iodoacetate, Action of, on Dehydrogenases and Alcoholic Fermentation, Dr. M. Dixon, 806
Ionic: Mobilities, Effect of Viscosity on, D. Belcher, 810; Clouds, Irregular, in the *E* Layer of the Ionosphere, T. L. Eckersley, 846
Ionization by Radioactive Gamma and Cosmic Rays in different Gases, J. Juilfs, 767
Ionosphere: Artificial, Anomalous Dielectric Content of, Prof. S. K. Mitra and K. K. Roy, 586; 1066; *E* Layer of the, Irregular Ionic Clouds in the, T. L. Eckersley, 846; Absorption of Wireless Waves in the, Annual variation of the, Dr. F. W. G. White and L. W. Brown, 931;
Ionospheric Disturbances, Catastrophic, An Effect of, on Low-frequency Radio Waves, K. G. Budden and J. A. Ratcliffe, 1060
Ions, Slow Positive, Diffraction of, A. G. Emslie, 463
Joule-Thomson Effect and Quantum Statistics, Dr. D. S. Kothari and B. N. Srivasava, 970
Jute, Trisomic Mutations in, Dr. H. K. Nandi, 973
Ketene, Preparation of, Products Formed during the, R. W. Hale, 1017
Ketones, Aldehydes and, Photo-decomposition of, Prof. R. G. W. Norrish and C. H. Bamford, 195
Kineses, Taxes and, Classification of, Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou, 1064
Krypton and Xenon, Packing Fractions of, Dr. F. W. Aston, 149
$L\alpha$ Emission Lines of Cu and Fe, Intensity and Structure changes of the, on Intense Cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464
L-Emission Bands of Zinc, Copper, Nickel and Cobalt Dr. J. Farineau, 508
Lactoflavin, the Coulter Compound, 'Cytochrome *b*', and Cytochrome *c*, Spectroscopic observations of reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
Lead Crystal Growths in Silica Gel, Spiriform Morphology of some, N. Stuart, 589
Lebistes: Succession of Broods of, G. L. Purser, 155; Dr. Ö. Winge, 467
Lecithin, Yolk, Origin of, L. Hahn and Prof. G. Hevesy, 1059

Lecithinæmia following the Administration of Fat, Prof. G. Hevesy and E. Lundsgaard, 275

Lemna minor, A short periodic Growth Cycle and a Secular Variation in, H. Dickson, 112

Lepidosiren, Cytology of, Prof. W. E. Agar, 931 ; Prof. E. W. MacBride, 932

Li + and He, Ionization Energy of, H. A. S. Eriksson, 151

Light : The Neutrino Theory of, V. Fock, 113 ; Neutrino Theory of, in Three Dimensions, A. Sokolow, 810 ; thought to have been seen in the neighbourhood of Alternate Current Magnets, The, Lord Rayleigh, 423 ; Diffraction of, by Ultrasonics at Oblique Incidence, Dr. F. Levi, 969

Lightning Discharges, Effect of near, on a Magnetometer, Dr. K. R. Ramanathan, 587

Liquid Drops at Interfaces, Visible Adsorbed Films and the spreading of, Prof. D. H. Bangham, S. Mosallam and Z. Saweris, 237

Liver, Fatty, Action of Pancreatic Extract on, B. Shapiro and Prof. E. Wertheimer, 771

Locusts in the Field, Phase transformation in, J. S. Kennedy, 889

Louse, Biting-, Distribution of the, N. J. B. Plomley and G. B. Thompson, 199

Low-Temperature Thermostat, An inexpensive, L. C. Beadle and F. A. Booth, 279

Lysozyme, Crystallization of, E. P. Abraham and Prof. R. Robinson, 24

Magnetic Storms : Cosmic Rays and, Prof. S. Chapman, 423 ; *Variations of Cosmic Ray Intensity during*, Prof. C. Störmer, 549

Meiosis and Mitosis, Artificial release of Crossing-over in, Prof. H. Friesen, 362

M-Emission Bands of Zinc, Copper and Nickel, Dr. H. W. B. Skinner and J. E. Johnston, 508

Mental : Factors, Selection and, Dr. G. H. Thomson, 934 ; Disturbances, Physiological Patterns and, J. W. Thompson, W. Corwin and J. H. Aste-Salazar, 1062

Merino, Trio Follicles in the, Non-specificity of the, Dr. A. B. Wildman, 891

Mesothorium-I, Concentration of, by Duckweed (*Lemna*), Prof. W. I. Vernadsky, B. K. Brunowsky, and C. G. Kunasheva, 317

Metal Films, Thin, Structure and Resistance of, D. A. Wright, 107

Metals : Rigidity of, Effect of Occluded Hydrogen on the, Father J. Lynch, 363 ; Oxide Film Formation on, Polarimetric studies of, A. B. Winterbottom, 364 ; of Hexagonal Structure, Asymmetry in, Dr. G. W. Brindley and P. Ridley, 461 ; Ferromagnetic, The Paramagnetic Magneton Numbers of the, Prof. W. Sucksmith and R. R. Pearce, 970 ; Structure of, Dr. A. Müller, 1011

Metabolism, Size and, Relation between, C. Ellenby, 853

Metaphosphoric Acid, Reaction between Proteins and, Dr. H. Herrmann and G. Perlmann, 807

Meteor, Bright, of November 9, A. E. Moon, 1102

Meteorites : The number of Pultusk Stones, and the spelling of "Widmanstätten Figures", Prof. F. A. Paneth, 504 ; 809 ; Dr. L. J. Spencer, 589

Methyl Halides, Carbon-Halogen Distance in the, Dr. G. B. B. M. Sutherland, 239

Mice, Sensitization of the Skin of, to Light by Carcinogenic Agents, Dr. I. Doniach and Dr. J. C. Mottram, 588

Milk, Off-flavoured, Acidosis and, Capt. H. Barkworth and L. W. L. Cole, 324

Mitosis, Meiosis and, Artificial release of Crossing-over in, Prof. H. Friesen, 362

Mitotic Spindle, Self-arrangement in the, under Mechanical Influence, Dr. H. H. Pfeiffer, 770

Molecular : Compounds, Organic, Structure of, Dr. J. S. Anderson, 583 ; Structure, Force Constants and, Dr. H. W. Thompson and J. W. Linnett, 1065

Molybdenum, Tellurium, Tungsten and, Hexaco-ordination of, J. Gupta, 685

Monomolecular Films, Viscosity of, Prof. W. D. Harkins and R. J. Myers, 465

Nd + + + Ion, Absorption Spectra evidence of the Decomposition of the Ground Term of, due to Crystalline Fields, Prof. D. M. Bose ; Dr. W. G. Penney and G. J. Kynch, 109

Nematodes, Physiology of, D. G. Davey, 645

Neural : Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the Ectoderm of the Anuran Gastrula, Prof. G. A. Schmidt, 199 ; Induction by Plant Tissues in the Ectoderm of the Gastrula of *Triton taeniatus*, M. N. Ragozina, 199

Neutrino : Theory of Light, The, V. Fock, 113 ; Shower, β-Decay as due to a, N. S. Nagendra Nath, 278 ; Theory of Light in Three Dimensions, A. Sokolow, 810

Neutron : Beams, Polarized, A method of obtaining, Dr. H. v. Halban, jun., 425 ; Levels, Resonance, of Silver, Rhodium and Bromine Nuclei, Spacing of the, C. Y. Chao and T. H. Wang, 768

Neutrons : Production of Mutations by, Mary Nagai and G. L. Locher, 111 ; Expulsion of, from Lead by Cosmic Rays, B. Arakatsu, K. Kimura and Y. Uemura, 277 ; inside Magnetized Iron, The Magnetic Field acting upon, Dr. O. R. Frisch, Dr. H. von Halban, jun., and Dr. J. Koch, 360 ; Slow, Capture of, in Light Elements, Dr. O. R. Frisch, Dr. H. von Halban, jun., and Dr. J. Koch, 895

Nickel Wire, Magnetic Quality of, as influenced by the Surface, Dr. T. F. Wall, 238

Nile, Dry Crossing of the, E. J. Wayland, 811

Nitric Oxide and Alkyl Ethers, Prof. M. W. Travers, 107

Nitrogen : Excretion of, by Leguminous Plants, Prof. P. W. Wilson, 154 ; Prof. A. I. Virtanen ; Dr. G. Bond, 683 ; Spectrum of, and Atmospheric Pressure at High Altitudes, R. Bernard, 930

Nuclear Particles, Interaction of, Dr. N. Kemmer, 192

Œstradiol Monobenzoate, Inhibition by, Response of the Pigeon Crop Gland to Prolactin : Dr. S. J. Folley and P. White, 505

Œstrous Reactions, including Mating, produced by Triphenyl Ethylene, J. M. Robson and Dr. A. Schönberg, 196

O_2+Bands, Visible, Rotational Analysis of the, T. E. Nevin, 1101

O-H Raman Frequency in Inorganic Acids, The, Dr. C. S. Venkateswaran, 151

Oil Drops, Collision of Two, and the Stability of a Non-spherical Oil Drop, Yoshio Ishida, 70

Optical Contact, Propagation of, Dr. J. Weir French, 321 ; Sensitizing of Silver Halides by Dyes, Mechanism of, Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker, 1096

Oxidation Catalyst, A New, J. G. Dewan and D. E. Green, 1097

Oxide Film Formation on Metals, Polarimetric studies of, A. B. Winterbottom, 364

Oxides formed on Iron, Electron Diffraction studies of, T. Iimori, 278

Oxonium Compounds, Raman Spectra of, Dr. G. Briegleb and W. L. Lauppe, 236

Oxygen in Sea Water, Consumption of, under Controlled Laboratory Conditions, H. R. Seiwell, 506

Oxyporphyrin Hæmatin Compound, An, as intermediate between Protohæmatin and Verdohæmatin, Dr. R. Lemberg, B. Cortis-Jones and M. Norrie, 65

Oyster and the Salmon, Sex-Biology of the, Prof. J. H. Orton, 68

Pacific Seismological Stations, Reliability of, Dr. H. Jeffreys, 237

Pancreatic Extract, Action of, on Fatty Liver, B. Shapiro and Prof. E. Wertheimer, 771

Papain, Natural Activation of, Prof. M. Frankel and R. Maimin, 1015

Para-Cresol from the Urine of Pregnant Mares, Dr. P. G. Marshall, 362

Pentaerythritol, Solid, Hydrogen Bridges in, I. Nitta and T. Watanabé, 365

Personnel Organization, A Psycho-geometrical Representation of, W. R. Dunlop, 152

Phosphate in Muscle, Coupling of Dismutations with Esterification of, Dr. Dorothy M. Needham and R. K. Pillai, 65

Phosphine and Arsine derivatives of the Group I(*b*) Metals : Volatile derivatives of Gold, Drs. F. G. Mann and A. F. Wells, 502

Phosphorus : and Calcium Deficiency Diseases as two Etiologically Distinct Entities, Dr. P. J. Du Toit and Dr. A. I. Malan, 153 ; Exchange in Yeast, Prof. G. Hevesy, Dr. K. Linderstrøm-Lang and N. Nielsen, 725

Photographic Plates, Sensitized, Position of Maximum Optical Sensitivity of, S. Natanson, 197

Photoperiodic After-Effect, Prof. R. H. Stoughton and D. R. Hole, 808

Photosynthesis of Carbohydrates *in vitro*, Prof. E. C. C. Baly, 930

Phycomyces, Growth Factors for, H. M. Sinclair, 361

Physiological Patterns and Mental Disturbances, J. W. Thompson, W. Corwin and J. H. Aste-Salazar, 1062

'Phytocarcinomata', Colchicine, and Plant Hormones, L. Havas, 191

Pituitary Extracts, Anterior, Rostropic effects of, C. Wetzler-Ligeti and Dr. B. P. Wiesner, 892

Plankton Collector, A, For Fast Towing, E. L. Pierce, 1014

Plant Hormones, Colchicine, 'Phytocarcinomata' and, L. Havas, 191

Plants, Net Assimilation Rate in, Drift of, R. F. Williams, 1099

Platyedra gossypiella Saunders, Nocturnal Habits of, F. A. Squire, 69

Polonium, The γ-Rays of, H. C. Webster, 852

Poly-Acids, Constitution of the, Dr. J. Stuart Anderson, 850

Polymerization, The Kinetics of, Prof. A. C. Cuthbertson, G. Gee and Prof. E. K. Rideal, 889

Polyploidy through Colchicine, Mechanism of, B. R. Nebel, 1101

Porphyrinuria, Congenital : Living Animal Cases of, P. J. Fourie and Dr. C. Rimington, 68 ; Porphyrins of the I and III Series in, Dr. C. Rimington, 105

Positron and Electron Pairs, Production of, by bombardment of Mercury with β-Particles of Low Energy, Dr. F. C. Champion and A. Barber, 105

Potassium, Resonance Lines of, Intensity Ratios of the Hyperfine Structure Components of the, Dr. D. A. Jackson and H. Kuhn, 276

Potato : Slopes, Standardization of, for Bacteriological Tests, D. Ward Cutler and Miss Mabel Dunkley, 1015 ; Flowers and Dissemination of Potato Viruses, Dr. G. Cockerham, 1100

Progesterone alone, Effects on Ovariectomized Rats of, and in combination with the other Sexual Hormones, Dr. V. Korenchevsky and K. Hall, 154

Prolactin : Response of the Pigeon Crop Gland to, Inhibition by Œstradiol Monobenzoate, Drs. S. J. Folley and P. White, 505

Proliferation-promoting Substances from Cells injured by Ultra-violet Radiation, G. S. Sperti, Prof. J. R. Loofbourow and Sister Cecilia Marie Dwyer, 643

Proteins : and Metaphosphoric Acid, Reaction between, Dr. H. Hermann and G. Perlmann, 807 ; 'Fibrous' and 'Globular' Relation between, Dr. W. T. Astbury, 968

Protoplasmic Streaming, Action of Auxin on, Prof. K. V. Thimann and Miss Beatrice M. Sweeney, 807

Protozoa, Effects of Salts on emergence from the Cyst in, K. V. Thimann and A. J. Haagen-Smit, 645

Pultusk : Meteorite, Number of Fragments of the, Dr. E. Stenz, 113 ; Stones, the Number of, Meteorites : and the spelling of "Widmanstätten Figures", Prof. F. A. Paneth, 504 ; 809 ; Dr. L. J. Spencer, 589

Purple, Visual, Absorption Curve for, and the Electrical Response of the Frog's Eye, Prof. R. Granit, 972

Pyruvic Acid Dehydrogenation, Vitamin B, and Cocarboxylase, F. Lipmann, 25

Quantum Statistics, Joule-Thomson Effect and, Dr. D. S. Kothari and B. N. Srivasava, 970

'Racemic Acid', Use of the name, Prof. A. Findlay, 22

Radioactive Substances in the body of Rats, Retention of, and the Lethal Dose, Dr. F. Běhounek and F. V. Novák, 106

Raman Spectra : of Oxonium Compounds, Dr. G. Briegleb and W. Lauppe, 236 ; of Deuteroethylenes, Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse, 323

Rare-Earth Sulphates, Magnetic Anisotropy of, and the Asymmetry of their Crystalline Fields, Prof. K. S. Krishnan and A. Mookherji, 549

Rats : Adrenals of Normal and of Castrated Male, Histological changes produced by Castration and by Sex Hormones in the, K. Hall and Dr. V. Korenchevsky, 318 ; Liver Extract and Hæmoglobin in, A. L. Bacharach and H. E. Glynn, 896

Reaction, Heat of, The Sign and Symbol of, Dr. H. J. S. Sand, 809

Refraction Effect in certain Fatty Materials, A Double, L. Bellingham, 70

Resins, Synthetic, Examination of, by X-Rays, N. J. L. Megson and W. A. Wood, 642

Resorcinol, A New Form of, A. R. Ubbelohde and Dr. J. M. Robertson, 239

Respiration, Artificial, Production of, by Rhythmic Stimulation of the Phrenic Nerves, Prof. R. A. Waud, 849

Rickets, Experimental, of Rats, Protective Effect against, of a Single Massive Dose of Vitamin D, Dr. H. Rotter, 973

River Flow Around Bends, Dr. B. Cunningham, 728

Rubber, Nature of the Diffusion Process in, R. M. Barrer, 106

Rye, Spring, Devernalization of, by Anærobic conditions and Revernalization by Low Temperature, Prof. F. G. Gregory and O. N. Purvis, 547

Salicylic Aldehyde Reaction of Csonka-Straub, Specificity of the, Prof. A. E. Braunstein, 427

Salmon, Oyster and the, Sex-Biology of the, Prof. J. H. Orton, 68

(*Scylliorhinus canicula*), Changes of Colour by injection of Pituitary Extracts in a Dogfish, D. R. Barry, 769

Se_2 Molecule, The Ground State of the, Prof. S. S. Bhatnagar, Dr. H. L. Lessheim and Mohan Lal Khanna, 152

Seasons, Nomenclature of the, Dr. J. R. Baker, 890

Sedimentation, Ultracentrifugal, Analytical Measurements of, A. Tiselius, K. O. Pedersen and Prof. The Svedberg, 848

Selection and Mental Factors, Dr. G. H. Thomson, 934

Sex Behaviour, Effect upon, of a Diet Deficient in Vitamin E, Dr. B. P. Wiesner and A. L. Bacharach, 972

Sheep Diseases, Cobalt, and, J. B. E. Patterson, 363

Showers, Production of, by Heavy Particles, Dr. L. Landau and G. Rumer, 682

Silica Dusts, Solubility of, Dr. E. J. King, 320

Silver Halides, Mechanism of Optical Sensitizing of, by Dyes, Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker, 1096

Sinanthropus pekinensis, Reconstruction of the Entire Skull of an Adult Female Individual of, Prof. F. Weidenreich, 1010

Skatole as a Root-forming Substance, L. G. G. Warne and A. A. Jackson, 26

Snow Crystal or Snowflake, Sir George Simpson, 729 ; G. Seligman, 730

Snowflake, Snow Crystal or, Sir George Simpson, 729 ; G. Seligman, 730

Solar : Eclipse of June 8, 1937, Observations of the, Prof. I. Yamamoto, 501 ; Corona, Polarization of the, K. G. Zakharin, 586 ; Eclipse, Total, of June 19, 1936, Coronal Emission Lines observed at the, Prof. R. Sekiguti, 724 ; Prof. F. J. M. Stratton, 725

Sound-Films as Diffraction Gratings for the Visual Fourier Analysis of Sound-Waves, Dr. D. Brown, 1099

Spark Discharge, Development of the, Dr. T. E. Allibone and J. M. Meek, 804

Spectrometers, Two, for X-Ray Analysis, W. F. de Jong, 768

Sterol Group, A Diene Synthesis applicable to the, A. B. Meggy and Prof. R. Robinson, 282

Sterols and the Bile Acids, Stereochemistry of the, D. A. Peak, 280

Stonefly, Graded Mutations in Wings of a, Prof. A. Willey, 112

Styrene, Catalysed Polymerization of, Kinetics of, Dr. G. Williams, 363

Substrate, Use of the word, Dr. N. K. Adam, 158

Taxes and Kineses, Classification of, Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou, 1064

Tellurium, *Molybdenum* and Tungsten, Hexaco-ordination of, J. Gupta, 685

Tenthredinidæ, Thelytokously Parthenogenetic, Maturation in the, Prof. A. D. Peacock and Dr. Ann R. Sanderson, 240

Ternary: Gas Mixtures, Analysis of, by Thermal Conductivity Measurements, J. L. Bolland and Dr. H. W. Melville, 63; Alloys, Investigation of Equilibrium Diagrams of, by X-Rays, A. J. Bradley, H. J. Goldschmidt, H. Lipson and A. Taylor, 543

Testosterone, Effect of Enol-Esters of, Dr. K. Miescher, W. H. Fischer and E. Tschopp, 726

Tetradeuteroethylene, Infra-red Spectrum of, Dr. G. B. B. M. Sutherland and G. K. T. Conn, 644

Tetramethyldiketopiperazine, Diketopiperazine and, Infra-red Spectrum and Molecular Structure of, Dr. L. Kellner, 193

Thallium Hydride, Band Spectrum of, Dr. B. Grundström, 365

Thorium, Disintegration of, Detection of α-Particles in the, A. Braun, Dr. P. Preiswerk and P. Scherrer, 682

Time–Space Continuum", "The, Designation of, Dr. M. O'Gorman, 773

Titanium Dioxide, Commercial, Darkening of some, in Daylight, W. O. Williamson, 238

Tobacco Mosaic Virus Nucleoprotein, artificially prepared Visible Paracrystalline Fibres of, R. J. Best, 547

Tri-brom Ethanol, Absorption of, through the Skin, Dr. D. I. Macht, 849

Triphenyl Ethylene, Œstrous Reactions, including Mating, produced by, J. M. Robson and Dr. A. Schönberg, 196

Triterium ?, Tritium or, Dr. K. C. Bailey, 590

Tritium or Triterium ?, Dr. K. C. Bailey, 590

Triton taeniatus, Ectoderm of the Gastrula of, Neural Induction by Plant Tissues in the, M. N. Ragozina, 199

Tumour Cells, Ærobic Glycolysis of, Specific action of Ferricyanide on, Dr. B. Mendel and Miss F. Strelitz, 771

Tungsten, Tellurium, Molybdenum and Hexaco-ordination of, J. Gupta, 685

Turbid Solutions in an Electric Field, Optical rotatory power of, Prof. J. Kunz and R. G. La Baw; Dr. E. B. Ludlam, A. W. Pryde and H. G. Rule, 194

Ultra-sonic Grating, Circular, in Liquids, Miss J. Ceřovská, 425

Uterus, Hæmodynamic Factors in the, during the Latter Part of Gestation, Dr. S. R. M. Reynolds, 546

Veddahs, Blood-groups of, Prof. W. C. O. Hill, 548

Vibration Temperature in relation to Rotation Temperature in Band Spectra, Dr. N. R. Tawde and S. A. Trivedi, 463

Vijayalaya Cholisvaram, Temple of, in Pudukottah State, Technique of the painting process in the, S. Paramasivan, 198

Virus Particles, Aggregation of, J. G. Bald and G. E. Briggs, 111

Vitamin: A, A new source of, Dr. J. A. Lovern, Dr. J. R. Edisbury and Dr. R. A. Morton, 276; A_2, A Possible, Dr. J. R. Edisbury, Dr. R. A. Morton and G. W. Simpkins, 234; B_1, Reduction of, a coloured intermediate on, F. Lipmann, 849; C, Excretion of, in Sweat, R. E. Bernstein, 684; E Concentrates from Rice- and Wheat-germ Oils, Constituents of, Dr. A. R. Todd, Dr. F. Bergel, H. Waldmann and T. S. Work, 361; E Deficiency in the Suckling Rat, Miss M. M. O. Barrie, 426; P, A. Bentsáth and Prof. A. Szent-Györgyi, 426; P, Dr. S. S. Zilva, 588; E, A Diet Deficient in, Effect upon Sex Behaviour of, Dr. B. P. Wiesner and A. L. Bacharach 972; D, A Single Massive Dose of, Protective Effect against Experimental Rickets of Rats of, Dr. H. Rotter, 978

Water, Heavy, Adiabatic and Isothermal Compressibilities of, Prof. S. Bhagavantam and B. Sundara Rama Rao, 1099

Whales Die ? Why Do Stranded, Prof. W. A. Osborne, 1017

Whirling Threads, Air-drag and the Equilibrium of, E. R. Goshawk, 194

"Widmanstätten Figures", the spelling of, Meteorites: the number of Pultusk Stones and, Prof. F. A. Paneth, 504; 809; Dr. J. Spencer, 589

Wireless Waves in the Ionosphere, Absorption of, Annual variation of the, Dr. F. W. G. White and L. W. Brown, 931

Wires, Internal Friction of, Dr. C. Zener, 895

Xenon, Krypton and, Packing Fractions of, Dr. F. W. Aston, 149

X-Ray: Microscopes, The, Dr. L. v. Hámos, 30; Intensifying Screens adapted to Structure Analysis, Dr. N. H. Kolkmeijer, C. J. Krom and H. Kunst, 67; Analysis, Two Spectrometers for, W. F. de Jong, 768

Yeast, Phosphorus Exchange in, Prof. G. Hevesy, Dr. K. Linderstrøm-Lang and N. Nielsen, 725

Yolk Lecithin, Origin of, L. Hahn and Prof. G. Hevesy, 1059

Zinc-blende, Photo-conductivity and Phosphorescence of, Dr. A. L. Reimann, 501

Zodiacal Light at a Total Solar Eclipse, The, Prof. F. J. M. Stratton, 682

Zoological Nomenclature, Prof. T. D. A. Cockerell, 27

Cosmic: Radiation, Longitude Effect and the Asymmetry of, Prof. G. Lemaître, 23; Dust Clouds, Evolution of, K. Hillebrand, 125; Ray Measurements, Use of Krypton-filled Ionization Chambers for, Dr. S. Ziemecki, 150; Radiation, Absorption of the Soft Component of, Dr. W. Heitler, 235; Rays, Expulsion of Neutrons from Lead by, B. Arakatsu, K. Kimura and Y. Uemura, 277; Bundles, Mechanism of the production of, P. Auger, P. Ehrenfest, jun., A. Freon and Mme. Thérèse Grivet, 292; Ray Intensity, World-wide effect in, as observed during a recent Magnetic Storm, Prof. V. F. Hess and A. Demmelmaire, 316; Rays and Magnetic Storms, Prof. S. Chapman, 423; Ray Intensity during Magnetic Storms, Variations of, Prof. C. Störmer, 549; Rays, Disintegration Processes by, with the Simultaneous Emission of several Heavy Particles, M. Blau and H. Wambacher, 585; Ray Burst, A, at a depth equivalent to 800 m. of Water, Dr. Y. Nishini and C. Ishii, 774; Rays, Abnormal Zenithal distribution of, M. G. E. Cosyns, 931

Cottons, Wild and Cultivated American, Homologous Loci in, Dr. S. C. Harland, 467

Coulter Compound, Lactoflavin, 'Cytochrome *b*', and Cytochrome c, Spectroscopic observations of reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466

Counter, A Universal, A. Dauvillier, 477

Countryside, Amenities of the (*Review*), 623

Covent Garden Laboratory, Work of the, 17

Cozymase in Invertebrate Muscle, Dr. S. Ochoa and C. G. Ochoa, 1097

Creatinine, Compounds of, with Alkali Hydroxides, A. Bolliger, 377

Cross, Dorothy Temple, research fellowships, award of, 103

Cross-Channel Ferry Service, 1091

Crossing-over, The Biology of, Dr. C. D. Darlington, 759

Crustacea, Body Orientation in, A. G. Lowndes, 241

Crystal Structure, Mineral Chemistry and, Prof. P. Niggli (*Review*), 783

Crystallization, Oriented, N. Matsumoto; S. Shimadzu, 978

Crystals: with Vitamin K Potency, H. J. Almquist, 25; Organic, Temperature variation of Magnetic Anisotropy of, P. N. Nilakantan, 29; Artificial Slip Formation in, A. W. Stepanow, 64; Sublimation and Condensation of, T. Alty, 814; Atomic Distances in, N. Elliott, 978; Volume-rectification of, B. K. Sen, 1102

Csonka-Straub, Salicylic Aldehyde Reaction of, Specificity of the, Prof. A. E. Braunstein, 427

Cu and Fe, Intensity and Structure changes of the $L\alpha$ Emission Lines of, on intense cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464

Cultural Successions in British Archæology, 1109
$CuSO_4.5H_2O$, Crystal Structure and the Magnetic Anisotropy of, Prof. K. S. Krishnan and A. Mookherji, 896
Cultural, Geographical and, Regions, Prof. P. M. Roxby, 605
Cyanin Synthesis (mixed solvent process), An improvement on, and the reaction of Orthothioformic Ester, T. Kimura, 695
Cyclol Hypothesis, The, and the 'Globular' Proteins, Dr. D. M. Wrinch, 940
Cyclones in the South Indian Ocean, N. R. McCurdy 34
Cyclotron, Rays produced by a, Biological effects of the, Prof. M. Nakaidzumi, K. Murati and Y. Yamamura, 359
'Cytochrome : *b*', Lactoflavin, the Coulter Compound, and Cytochrome *c*, Spectroscopic observations of reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
Cytological Technique for Plant Breeders, Outline of, 273
Cytology : Recent Advances in, Dr. C. D. Darlington. Second edition (*Review*), 1033 ; The New, Dr. F. W. Sansome (*Review*), 1033
Cytoplasm, Cell Nucleus and, Interaction between, Prof. C. Stern, 770 ; Dr. C. D. Darlington, 932

Dalradian Rocks of the Sperrin Mountains, J. J. Hartley, 251
Darwin in Uruguay, Dr. J. D. Falconer, 138
Dates of Publication, Problem of, 499
Davis Strait, Oceanography of, 687
Daylight : Submarine, Measurement of, Dr. H. H. Poole, 50 ; Illumination necessary for Clerical Work, L. H. McDermott, 201
Dead Sea, Œstrogenic Substances in the, Prof. B. Zondek, 240
Death from the Skies : a Study of Gas and Microbial Warfare, H. Liepmann (with the scientific assistance of Dr. H. C. R. Simons). Translated by Eden and Cedar Paul (*Review*), 176
Decapod Crustacea, Larvæ of, Dr. R. Gurney, 692
Découverte : Palais de la, Congrès du, International Meeting in Paris, Prof. M. Polanyi, 710 ; Physics, J. G. Crowther, 710 ; Biology, 712 ; Biological Chemistry, Dr. E. F. Hartree, 714
Deep : Drilling Problems, Geological Aspects of, W. E. V. Abraham, 73 ; Well Drilling, G. Elias, 1093
Defence and Economic Adjustment, 907
Dehydroandrosterone, Cholesterol and, Oxidation of, by means of Osmic Acid, Prof. M. Ushakov and A. Lutenberg, 466
Dekane und Dekansternbilder : ein Beitrag zur Geschichte der Sternbilder der Kulturvölker, Dr. W. Gundel (*Review*), 701
Delaware Ceremonies and Dances, F. G. Speck, 32
Dental Amalgams, Dr. Marie L. V. Gayler, 858
Design : a Treatise on the Discovery of Form, P. E. Nobbs (*Review*), 873
Determinism, Free Will or, Dr. M. Davidson (*Review*), 871
Deuterium, Heterogeneous Equilibria with, Prof. J. R. Partington and R. P. Towndrow, 156
Deuteroethylenes, Raman Spectra of, Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse, 323
Devil's Dyke, Wheathampstead, gift of, as an open space by Lord Brocket, 764
Diatom Floras, Arctic and Antarctic, Dr. Mann, 1019
Diborane, Structure of, S. H. Bauer, 552
Diene Synthesis, A, applicable to the Sterol Group, A. B. Meggy and Prof. R. Robinson, 282
Dietetics : Nutrition and (*Review*), 829 ; Simplified : the use of Foods in Health and Disease, Prof. L. Jean Bogert. With Laboratory section by Mame T. Porter (*Review*), 829
Differential Systems, Prof. J. M. Thomas (*Review*), 950
Diffraction Gratings and Replicas, Recent improvements in, Prof. R. W. Wood, 723
Digestion, Artificial [1837], 167
Diketopiperazine and Tetramethyldiketopiperazine, Infrared Spectrum and Molecular Structure of, Dr. L. Kellner, 193
6 : 7-dimethoxybenzoparathiazine, Derivatives of, K. J. Baldick and F. Lions, 695
Dirigible Balloons, Inflammation of, A. Milhoud, 518
"Discovery" Investigations, 290 ; The Voyages of the, 529 ; Committee, Work of the, 571
Dispersoids, Organic and Inorganic, Electrical Precipitation of the Disperse Phase of, by Radium Emanation, E. Epstein, 1074
Domestic Fowl, Sex Ratio in the, and its Bearing upon the Sex-linked Lethal Theory of Differential Mortality, Prof. F. A. E. Crew, 1027
Dorchester, Roman, Excavation of, 311
Dove Marine Laboratory, Cullercoats, Report of the, 731
Drilling of a Deep Pressure Test in India, G. F. Wilson, 430
Drosophila : pseudo-obscura, Eye Pigment Development in, Flora Cochrane, 292 ; Spontaneous Chromatin Rearrangements in, Prof. R. Goldschmidt, 767 ; *melanogaster* : Ovary Transplants in, Meiosis and Crossing-over in Super Females, G. W. Beadle and B. Ephrussi, 779 ; Parallel Mutations in, Linkage relations of, Dr. A. H. Sturtevant and Dr. C. C. Tan, 812 ; New Mutation in, Prof. F. A. E. Crew and Dr. C. Auerbach, 898 ; Gene Doublets as evidence for adjacent Small Duplication in, Dr. H. Grüneberg, 932 ; *melanogaster* : Chromosomes of, Frequency of induced breaks in, B. P. Kaufmann and M. Demerec, 943 ; Puparium formation in Lethal Larvæ of, an accelerating effect of normal "ring-glands" on, E. Hadorn, 943 ; and *Lymnæa*, Temperature and the Growth of, T. Imai, 1067
Drunkenness, Cure for [1837], 167
Duckweed (*Lemna*), Concentration of Mesothorium-I by, Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunasheva, 317
Dune Drainage System, A, V. J. Chapman, 592
Durham University : Centenary of the, 55 ; conferment upon Prof. W. M. Thornton of the title of emeritus professor ; Dr. E. Williams appointed lecturer in electrical engineering, 435 ; Philosophical Society, election of officers, 967
Duše Rostlin (The Soul of Plants), Prof. B. Němec (*Review*), 1081
Dust Control in Industry, J. D. Leitch and L. B. Leppard, 772 ; Prof. H. V. A. Briscoe, 773
Dybsø Fjörd, Invertebrates of, Dr. K. Larsen, 1018
Dynamics, A. S. Ramsey. Part 2 (*Review*), 217

Ear, Response of the, to a Phase Reversal, C. S. Hallpike, Prof. H. Hartridge and Dr. A. F. Rawdon-Smith, 74
Earl's Court Exhibition Centre, 188
Earth Goddess : The, a Study of Native Farming on the West African Coast, G. Howard Jones (*Review*), 698
Earthquake : Baffin's Bay, of 1933, Dr. A. W. Lee, 369 ; in Sussex, Recent, 498 ; in Kashmir, November 14, 886 ; Swarm of Itô, Japan, F. Kishinouye, 977
Earthquakes : Deep-focus, in the South-West Pacific, R. C. Hayes, 855 ; American, Recent, 899 ; off the Coast of Northern California, Prof. Byerly, 937 ; Tokyo, of 1936, 1093
East Anglia and Germany, Pleistocene relations in, Dr. F. E. Zeuner, 647
Easton Park, Dunmow, gift of, as a Nature Sanctuary by the Countess of Warwick, 800
Eclipse Photography, Natural Colour, E. R. Hewitt, 271
Eclipses of the Sun and Moon, Sir Frank Dyson and Dr. R. v. d. R. Woolley (*Review*), 991 ; The Physical Interest of (*Review*), 991
Economic : Reforms required for Lasting Prosperity and Peace, A. G. McGregor, 354 ; Research and Industrial Policy, Prof. P. S. Florence, 411 ; Adjustment, Defence and, 907
Ecuador, South-Western, Geology of, Dr. G. Sheppard. With a chapter on the Tertiary Larger Foraminifera of Ecuador, by Dr. T. W. Vaughan (*Review*), 1035
Edinburgh : Astronomical Association, bequest to the, by J. H. Lorimer, 886 ; University : conferment of honorary doctorates on Prof. L. H. Baekeland, Sir William Bragg, Dr. N. Murray Butler, Sir Herbert

Grierson and Dr. A. Morgan, 80; conferment on the Queen of an honorary doctorate, 98
Education: in Industrial Management, E. S. Byng and G. A. Robinson, 79; Technical, Grammar Schools and, Dr. E. Benson, 79; The Informative Content of, H. G. Wells, 415; Early, Philosophy of, 479; General Physiology in, 659; Universities and, Prof. F. G. Baily and others, 689; Adult, in the United States, Dr. J. W. Studebaker, 816
Educational: Equipment for the New Age, 85; Films, 540
Eelworm, Root-Knot, G. F. Wilson, 898
Egypt: Exploration Society, Excavations of the, in Nubia, 1936–37, 78; Lower, Temperature and Relative Humidity in the Atmosphere over, W. D. Flower, 813; Ancient, Bull Cults of, Dr. Drioton, 1067
Egyptian: University Scientific Expedition to South-West Arabia, Dr. S. A. Huzayyin, 513; Music, Modern, Modes in, M. Mokhtar and Dr. A. M. Mosharrafa, 548
Elasmobranch Fishes, Colour Changes in, G. H. Parker, 469
Electric: Furnaces, D. Campbell, 59; Cables, Earthing the Metal Sheathing of, 579; Spark in Air at Atmospheric Pressure, Influence of Electric and Magnetic Fields on the, L. Bull and P. Girard, 1110
Electrical: Engineers, Institution of, election of officers, 104; award of scholarships of the, 422; Contacts, Commutable and Stable, G. A. Boutry and G. Tréherne, 251; Equipment, The, and Automobiles, Prof. S. Parker Smith. Third edition (*Review*), 704; Accidents in 1936, H. W. Swann, 887; Engineers, Institution of, Presentation to, of a Portrait of S. Evershed, 1094
Electricity: in Solids, Conduction of, R. W. Pohl and others, 204; and Marketing, F. H. Slade, 311
Electrification of the Paris–Orléans and Midi Railways, A. Bachellery, 1025
Electrodeless High-frequency Discharge, Effect of a Magnetic Field on the, E. W. B. Gill, 1061
Electrodynamics, Validity of Laws of, W. F. Dunton, 245; Dr. A. E. Clayton, 246
Electrolytes: Strong, Surface Tension of, Prof. M. Dole, 464; Strong, Conductance of Mixtures of, K. A. Krieger and M. Kilpatrick, 1020
Electrolytic Condensers: their Properties, Design and Practical Uses, P. R. Coursey (*Review*), 636
Electron: Positron and, Pairs, Production of, by bombardment of Mercury with β-Particles of Low Energy, Dr. F. C. Champion and A. Barber, 105; Tubes, The Physics of, Dr. L. R. Koller. Second edition (*Review*), 133; Diffraction Studies of Oxides formed on Iron, 278; Pairs, Creation of, by Nuclear Capture of Neutrons, H. S. W. Massey, 292; Diffraction: and Surface Structure, Prof. G. I. Finch (Bedson lecture), 800; in Crystals, Dr. P. P. Ewald, 928
Electronic Charge, Determination of, by the Oil Drop Method, Y. Ishida, I. Fukushima and T. Suetsugu, 29
Electrons: Measurement of the Nuclear Absorption of, by the Atmosphere up to about 10^{10} Electron-Volts, Prof. I. S. Bowen, Prof. R. A. Millikan and Dr. H. V. Neher, 23; Orbital, Capture of, F. Hoyle, 235
Electrostatic Valve, The, M. Pauthenier, M. Feldenkrais and L. Vigneron, 518
Electrotor Smoke and Dust Meter, Dr. S. C. Blacktin, 331; 582
Element: 43, Radioactive Isotopes of, C. Perrier and Prof. E. Segrè, 193; 87 (Ml), New Researches on the, H. Hulubei, 1111
Elements, Constitution of, Richard Watson and the, Prof. H. A. Harris, 926
Ellsworth Trans-Antarctic Flight, Map of, W. L. G. Joerg and O. M. Millar, 648
Embryology, A Textbook of, Prof. H. E. Jordan and Prof. J. E. Kindred. Third edition (*Review*), 949; Human, Dr. F. H. A. Marshall (*Review*), 949
Empiricism, Logic and, Dr. T. Greenwood (*Review*), 866
Enke's Comet, 500
Engineering: Fundamentals, Handbook of. Edited by O. W. Eshbach (*Review*), 91; Research in, Sir Alexander Gibb, 412; and Marine Exhibition at Olympia, 553; Military. Vol. 6: Water Supply (*Review*), 705; and Transport, Sir Alexander Gibb, 719; Progress of, Bryan Donkin, 798; Professions, Co-operation between the, Sir George Lee, 799; Progress in the Navy, Prof. C. J. Hawkes, 1024
England under Trust: the Principal Properties held by the National Trust in England and Wales. Described and illustrated by J. Dixon-Scott (*Review*), 623
Enol-Esters of Testosterone, The effect of, Dr. K. Miescher, W. H. Fischer and E. Tschopp, 726
Entomological Society [1837], 250
Enzyme: Research (*Review*), 563; Chemistry, Dr. H. Tauber (*Review*), 948
Enzymforschung, Ergebnisse der, Herausgegeben von F. F. Nord und R. Weidenhagen. Band 6 (*Review*), 563
Enzymologia, vols. 3 and 4, 923
Estate Woodlands, Present and Future of, Hon. Nigel Orde-Powlett, 817
Estuary Channels and Embankments, Dr. B. Cunningham (Vernon-Harcourt lecture), 1046
Ethnological Museums: Methods and Limitations, Dr. H. S. Harrison, 57
Ethyl-chlorophyllide, Elementary Cell and Space group of, Dr. J. A. A. Ketelaar and E. A. Hanson, 196
Ethylene: Bromide, Thermal Decomposition of, Prof. T. Iredale and A. Maccoll, 24; Hydrocarbon Derivatives of, Œstrogenic Activity of some, Prof. E. C. Dodds, M. E. H. Fitzgerald and W. Lawson, 772
Europäischen und mediterranen Ottern und ihre Gifte: Die, Grundlagen zur Darstellung eines Wirksamen Schlangenserums, Prof. R. Bieling, and others (*Review*), 744
European Ethnology and Folklore, International Association for, Conference at Edinburgh, 206
Evans' Biological Institute, Extension of, 676
Everest, Conquering, Problems of, E. Shipton, 394
Everglades National Park, U.S.A., The proposed, Dr. J. K. Small, 263
Evolution: Directive (*Review*), 870; A Catechism of (*Review*), 912; and its Modern Critics, Dr. A. Morley Davies (*Review*), 912
Evolutionary Thought, The History of, as recorded in Meetings of the British Association, Sir Edward B. Poulton, 395
Examiners, Indulgent [1837], 434
Excitation in Living Material, Transmission of, A. L. Hodgkin and others; Dr. W. A. H. Rushton, 118
Exhibition, 1851, studentships and scholarships, award of, 60
Experiment, The Function of, Dr. E. C. Childs, 852

Faraday House Electrical Engineering College, Earl of Rothes appointed chairman of governors, 190
Faraday and Schönbein [1837], 517
Faraday's: Diary [1837], 655; Experimental Researches [1837], 1072
Faroes: Invertebrates of the, Dr. A. D. Imms, 733; Zoology of the, Edited by A. S. Jensen, W. Lundbeck, T. Mortensen and R. Sparck. Vol. 2, part 1, 733
Fast, A Simulated [1837], 904
Fatigue and Air Movement in Rooms, J. R. Henderson, 976
Fe—C, System, A New Equilibrium Diagram for the, Dr. I. Iitaka, 462
Fe, Cu and, Intensity and Structure Changes of the $L\,\alpha$ Emission Lines of, on intense Cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464
Fermente und ihre Wirkungen, Die, Prof. C. Oppenheimer. Supplement. Lief 6 (*Review*), 873
Fernrohre, Die, und Entfernungsmesser, Dr. A. König. Zweite Auflage (*Review*), 831
Ferns, Hybrid [1837], 819
Ferret, Embryology of the, W. J. Hamilton, 775

Ferricyanide, Specific action of, on *Ærobic* Glycolysis of Tumour Cells, Dr. B. Mendel and Miss F. Strelitz, 771
Ferromagnetism, Size of Particles responsible for, D. Beischer and A. Winkel, 202
Ferskvandsfaunaen, biologisk belyst: Invertebrata, Prof. C. Wesenberg-Lund. Bind 1, 2 (*Review*), 992
Fibres Cores in Winding Ropes, 818
Finney-Howell Research Foundation, The, 1009
Finsler Comet, 1937*f*, Rapid Changes in the Tail of the, J. Ellsworth, 985
Fireball Train, Observation of a, M. A. Ellison, 244
Fires, Fighting, Devices for, T. Rich, 271
Fish: Oils, New Zealand, F. B. Shorland, 223; Liver Oils, Freshwater and Marine, Chromogenic properties of, Differences in the, A. E. Gillam, Prof. I. M. Heilbron, Dr. E. Lederer and V. Rosanova, 233; Japanese, Barbels of, M. Sato, 429; Mentality of, Dr. J. Gray, 496; *Freshwater, Blindness in*, Dr. W. Rushton, 1014
Fishes: Indian, Researches on, Sunder Lal Hora; P. Sen, 367; Giant, Whales and Dolphins, J. R. Norman and Dr. F. C. Fraser (*Review*), 911
Fjord Formation, N. E. Odell, 855
Flavenols: Synthesis of, Oxidation of Flavindogenides, Prof. J. Algar and Isabella P. Carey, 292
Fletcher, late Sir Walter Morley, Memorial to, 357
Flight, Interpretative History of, M. J. B. Davy (*Review*), 637
Flints and Flint-working, Exhibition of, at the British Museum (Bloomsbury), 677
Floral Morphology: a New Outlook, with special reference to the interpretation of the Gynæceum, Miss E. R. Saunders. Vol. 1 (*Review*), 132
Flower, The Structure of the (*Review*), 132
Fluid Mechanics, An Introduction to, A. H. Jameson (*Review*), 635
Fluids, Insulating Power of [1837], 434
Fluorine: Intoxication, K. Roholm (*Review*), 483; Poisoning, Dr. M. M. Murray (*Review*), 483
Fluoroform, A. L. Henne, 593
Flying Records, New, Flying-Officer A. E. Clouston and Mrs. Kirby-Green, 888; 929; M. Codos, 929
Folk-Lore, Scientific Study of (*Review*), 785
Food: Science and the Conservation of, T. Macara, 203; Investigation Board, Report of the, for the year 1936, 956
Foods and Nutrition, Elements of, Mary T. Dowd and Prof. Alberta Dent (*Review*), 829
Foodstuffs, Transport and Storage of, Progress in the, 956
Foot-and-Mouth Disease, 925
Forbes, J. D., among the Dolomites [1837], 476
Force Constants and Molecular Structure, Dr. H. W. Thompson and J. W. Linnett, 1065
Forest Bibliography to 1933, 1092
Forestry: Commission, Sixteenth annual report of the, 692; in Great Britain, 692; Research in Malaya, 1091
Forthcoming Books of Science, 638
Fortified Hill-top Site in Sussex, 540
Fossil: Insects from Kansas Rocks, late Dr. R. J. Tillyard; A. Martynov; F. M. Carpenter, 116; Discoveries in France [1837], 556; Man in Minnesota, 596; Insects from the *Permian of Kansas*, late Dr. R. J. Tillyard, 1104
Foulerton Research Fellowship, Dr. M. C. G. Israels appointed to a, 1058
Fractionation Coefficients of Salts possessing several Hydrates, B. Goldschmidt, 477
France: La Société Astronomique de, Jubilee of, 17; College de, [1837], 1026
Franklin Institute [1837], 693
Free: Will: or Determinism, Dr. M. Davidson (*Review*), 871; Science and (*Review*), 871; Radicals in Solution, Dr. D. H. Hey and Dr. W. A. Waters, 934
French: Railway, First [1837], 333; Society of Chemical Industry: Seventeenth Congress in Paris, 672
Freud and Marx: a Dialectical Study, R. Osborn (*Review*), 344
(*frigadreactions*), New Transformations produced at Low Temperatures, A. Debierne and L. Goldstein, 656
Frog's Eye, Electrical Response of the, Absorption Curve for Visual Purple and the, Prof. R. Granit, 972
Fruit: Supplies in 1936, 581; -cooling Plant at Cape Town, 802
Fruits: Insects and allied Pests of, G. Fox-Wilson (*Review*) 215; and Hops, The Pests *of*, Dr. A. M. Massee (*Review*), 215
Fuel Interests, Co-ordination of, Sir Philip Dawson, 763
Fulgurites from Witsands, Kalahari, A. D. Lewis, 368
Fungi, Polyporaceous, Dr. S. R. Bose, 592
Fungus Gall, A New, Miss Janet M. Wilson, 1019

γ-Rays of Polonium, The, H. C. Webster, 852
γ-Rays, X- and, Biological action of, Some Quantitative aspects of the, C. M. Scott, 936
Gagea spathacea, Cytology of, Dr. M. Westergård, 551
Galileo and Mathematical Demonstration, W. C. Fahie; G. J. Whitrow, 646
Gallium: Das, eine kritische Würdigung der Erkenntnisse mit experimentellen Beiträgen, Dr. E. Einecke (*Review*), 566; F. Sebba and W. Pugh (4), 656; Germanium and, Preparation of, Sir Gilbert Morgan and Dr. G. R. Davies, 688
Galvani: Bicentenary of, 391; 836; The, and the Aldini Writings on Animal Electricity, a Bibliographical Study of, Prof. J. F. Fulton and Prof. H. Cushing, 840
Galvanometer Shunt, a Convenient form of, for use with Rectifier Photo-cells, H. H. Poole, 376
Game: Research, 616; Sanctuaries or National Parks, 651
Ganglia, Superior Cervical, Choline Esterase activity of, D. Glick, 426
Gā People, Religion and Medicine of, Miss M. J. Field (*Review*), 869
Gardening, No. 1, 1008
Gas: Warfare, Offence and Defence in, Major-Genl. C. H. Foulkes (*Review*), 3; Thermometers, Differences in the Indications of, W. Jacyna, 167; Engineers: Institution of, Autumn Research Meeting, H. J. Hodsman, 903
Gases: and Metals: an Introduction to the Study of Gas-Metal Equilibria, Dr. C. J. Smithells (*Review*), 385; Imperfect, The Cluster Theory of, Dr. C. F. Goodeve, 424; Rare, Chemical Properties of the, B. A. Nikitin, 643; Permanent, Pressure of Some, at Low Temperatures in the Presence of Silica Gel, R. Delaplace, 985; Pure, Conductivity of, at High Pressures, J. Clay and G. van Kleef, 1111
Gasometric Technique, Principle of the Cartesian Diver applied to, Dr. K. Linderstrøm-Lang, 108
Gassendi, Pierre, Prof. P. Humbert, 732
Geissler Discharge, Stratified, in Different Gases at Atmospheric Pressure, J. Jaffray, 477
Gem-Stones (*Review*), 703
Gems: The Story of the, a popular Handbook, H. P. Whitlock (*Review*), 703
Gene Linkage, Transitive Interference in, Prof. K. de Körösy, 322
General Register Office, Centenary of the, 56
Genetical Society, Summer Meeting, 314
Genetics: and Plant Breeding in the U.S.S.R., 296; Mendel, Morgan and, Prof. E. W. MacBride, 348; The Position of, Prof. J. B. S. Haldane, 428; and Taxonomy, Dr. W. B. Turrill, and others, 572; Eighth International Conference of, 803
Génétique, Exposés de, 2: L'Effet de position et la théorie de l'hérédité, Prof. T. Dobzhansky (*Review*), 788
Geodesy, International, Development in, Dr. J. de Graaff Hunter, 75
Geographical: Association, Sir Thomas Holland elected president of the, 582; and Cultural Regions, Prof. P. M. Roxby, 605
Geological: Congress, International, Seventeenth, Prof. W. T. Gordon, 789; Society of London, Dr. W. A. J. M. van Waterschoot van der Gracht, Dr. W. J. Jongmans, Dr. A. Renier and Dr. F. E. Wright elected foreign fellows and Prof. N. L. Bowen, Prof. R. M. Field, Baron F. von Huene and Prof. H. Stilles,

foreign correspondents, 883; Investigation, A Century of, Prof. W. W. Watts (*Review*), 915; Survey of Great Britain, The first hundred years of the, Sir John Smith Flett (*Review*), 915
Geology: Engineering, Prof. H. Ries and Dr. T. L. Watson. Fifth edition (*Review*), 259; in Engineering, Dr. B. H. Knight (*Review*), 259; in Schools, The Teaching of, 595
Géométrie infinitésimale, Éléments de, Prof. G. Julia. Deux. édition (*Review*), 950
Geonemertes dandyi Dakin, a Land Nemertean in Wales, A. R. Waterson and H. E. Quick, 292
German: Scientific Association [1837], 655; Physical Society, award of the Planck medal to Prof. E. Schrödinger, 722
Germanium and Gallium, Preparation of, Sir Gilbert Morgan and Dr. G. R. Davies, 688
Germany: Economic Position and Outlook in, A. Parker, 541; Physical Education in (*Review*), 561; Population Policy in, Dr. Danzer; Dr. A. Moritz, 678
Gibbs: J. Willard: A Commentary on the scientific writings of. Vol. 1, edited by Prof. F. G. Donnan and Prof. A. Haas; Vol. 2, edited by Prof. A. Haas (*Review*), 298; and his work (*Review*), 298
Gibraltar Man, 961
Giorgi's System of Units, Dr. A. E. Kennelly, 20
Glaciation of the Midlands, Prof. L. J. Wills, 409
Glacier Lakes and local Glaciers of the Wicklow Hills, Map of the, Prof. J. K. Charlesworth, 251
Glasgow: and West of Scotland College of Domestic Science, Anne R. Macarthur, 421; University: Prof. G. Barger appointed regius professor of chemistry, 537, 556; Dr. N. Morris appointed professor of materia medica and therapeutics, 556; Dr. P. Bacsich appointed lecturer in embryology; Dr. H. E. C. Wilson appointed lecturer in pathological and biochemistry at the Royal Hospital for Sick Children, 654
Glass Electrode, Mechanism of the, G. Haugaard, 66; and Silica, Surface Layers on, Lord Rayleigh, 470; Technology, Society of, Twenty-first anniversary of the, 884; Technology, Twenty-one years of, 1071
Glasshouse Industry, Development of the, Dr. W. F. Bewley; F. A. Secrett, 887
Glastechnische Fabrikationsfehler, Dr. H. Jebsen-Marwedel; M. Parkin (*Review*), 830
Glazes, Chinese, Scientific aspect of, Sir Gilbert Morgan (*Review*), 382
Gliadin, Individuality of, Prof. A. G. Kuhlmann, 119
Gliding, Progress in, 146
'Globular' Proteins, The Cyclol Hypothesis and the, Dr. D. M. Wrinch, 940
Glucolysis, Embryonic, Glyceraldehyde and, Dr. J. Needham and H. Lehmann, 198
Glyceraldehyde and Embryonic Glucolysis, Dr. J. Needham and H. Lehmann, 198
Glycerophosphoric Dehydrogenase, Dr. H. Weil-Malherbe, 725
Glycogen, Cellulose, Starch and, Prof. H. Staudinger, 1071
Glycolysis in Muscle Extracts, The Initial Stages of, Dr. L. P. Kendal and Dr. L. H. Stickland, 360
Gmelins Handbuch der anorgischen Chemie Achte Auflage. System-Nummer 36: Gallium; System-Nummer 37: Indium; System-Nummer 23: Ammonium. Lief 2: Verbindungen bis Ammonium und Kalium, Hydrazonium, Hydroxylammonium; System-Nummer 59: Eisen. Teil A, Lief. 8: Fe–C (Fortsetzung); mechanische und thermische Eigenschaften; Systeme Fe–C–H bis Fe–Be–K; System-Nummer 59: Eisen. Teil D: Magnetische und elektrische Eigenschaften der legierten Werkstoffe (*Review*), 953
Goethe medal for art and science, award of the, to Prof. E. Lexer, 148
Gold: in Plant Ash, Prof. B. Němec, 73; Mining with the aid of Aeroplanes, W. Bullock, 100; The Metallurgy of, Sir Thomas Kirke Rose and W. A. C. Newman. Seventh edition (*Review*), 258; Films, Thin, Production of, Prof. C. A. Gibson, 279; Standard, A Managed, E. A. Meyer, 354; Volatile Derivatives of, Phosphine and Arsine Derivatives of the Group I (*b*) Metals: Drs. F. G. Mann and A. F. Wells, 502; Mirrors, Constitution of Aurous Compounds: Prof. C. S. Gibson, 583
Golden: Bough, Aftermath: a Supplement to the, Sir James George Frazer (*Review*), 260; Gate Fair, 1056
Gossage and the Alkali Industry [1837], 291
Göttinger Sieben", "The, [1837], 1110
Government: Experimental Distillery [1837], 655; Chemist, Deputy, Dr. A. G. Francis appointed, 844
Graham Thomas, at University College, London [1837], 81
Grammar Schools and Technical Education, Dr. E. Benson, 79
Gran Chaco, Meteorites of the, 1006
Grand Junction Railway [1837], 39
Graphite, Colloidal, an effect of X-Radiation on the ζ Potential of, Prof. J. A. Crowther and H. Liebmann, 28
Grass: Drying, E. J. Roberts, 243; Dr. R. E. Slade, 1089; and the Nation's Food Supply, Dr. R. E. Slade, 456
Grassland: Management in Great Britain, Prof. R. G. Stapledon, 99; Congress, Fourth International, 248; Dr. D. S. Huizinga elected president of the fifth congress, 249
Gravimetric Analysis: a Laboratory Manual with special reference to the analysis of Natural Minerals and Rocks, W. van Tengeren (*Review*), 665
Gravitational Statics in Three Dimensions, S. G. Emslie, 729
Gravity in the Levant, Acceleration of, P. Lejay, 694
Great Western, S.S., Launch of the [1837], 123
Greenland: Culture: (1) The Norsemen, Dr. A. Roussell and others, 52; (2) The Eskimo, 177; and Europe, Meteorological Connexions between, Dr. F. Loewe, 593; the Birch 'Forests' of, Dr. N. Polunin, 939
Greifswald University, Prof. T. Vahlen made an honorary professor in, 21
Gresham College [1837], 777
Grid System, British, J. Wright, 394
Growth: Factors, Prof. F. Kögl and others, 161; Substances, Relation of, to Horticultural Practice, Dr. M. A. H. Tincker, 594
Gutenberg, Monument to [1837], 291
Gynandromorphism and Lateral Asymmetry in Birds, Prof. F. A. E. Crew and S. S. Munro, 1027
Gyro Compass on the Hudson Bay Route, 311

Haboobs in the Sudan, J. S. Farquharson, 687
Hæmocyanin Molecule, Splitting of the, by Ultra-sonic Waves, S. Brohult, 805
Hæmorrhagic States, The, Prof. L. J. Witts and others, 243
Hailey National Park, E. A. Smythies, 651
Haldane: Lord, A Life of (*Review*), 989; 1856–1915: the Life of Viscount Haldane of Cloan, K.T., O.M., Major-Genl. Sir Frederick Maurice (*Review*), 989
Halle Academy, The, 1652–1937, 179
Hallucinations scientifiques (les portulans), Prince Youssouf Kamal (*Review*), 662
Haloes, Pleochroic, Some New Types of, Prof. G. H. Henderson, 191
Hamburg Observatory, Astronomical work at the, 649
Hanseatic Scholarships, Foundation of, 719
Harmonic Analyser, A new, J. Harvey, 74
Harvard University: Physics at, 356; Medical Schools, Dr. J. E. Gordon appointed professor of preventive medicine and epidemiology, 582
Hawaii, Interracial Marriage in, Dr. R. Adams (*Review*), 665
Hawthorn, A Disease of, W. J. Dowson and W. A. R. Dillon Weston, 116
Hay Railway, 1810–1864, History of the, Capt. F. B. Ellison, 964
He, Li^+ and, Ionization Energy of, H. A. S. Eriksson, 151
Health: Ministry of, Eighteenth annual report of the, 271; and the Community, 493; 538; and a Day, Lord Horder (*Review*), 705; Nutrition and, 874; Legislation in Industry, Wider Issues of, Dr. L. P. Lockhart, 1090

Heat: Production, Nutrition and Growth in Man, Dr. E. P. Poulton, 413; of Reaction, The Sign and Symbol of, Dr. H. J. S. Sand, 809
Heavy Water, Adiabatic and Isothermal Compressibilities of, Prof. S. Bhagavantan and B. Sundara Rama Rao, 1099
Helium: Liquid, Heat Conduction in, Dr. J. F. Allen, Dr. R. Peierls and M. Zaki Uddin, 62; α-Particles in, Loss of charge of, F. Viehfeger, 125; Hydrogen and, Isotopes of, of Mass 3, The search for the, Lord Rutherford, 303; I and II, Refractive Indexes of, Prof. E. F. Burton, 1015
Hemipterous Insects of the family Peloridiidæ, I. W. Helmsing and W. E. China, 326
Herbage: and Foreign Seeds, G. Evans, 1018; F. J. Crider and M. M. Hoover, 1019; Plants, Associated Growth of, H. C. Trumble and T. H. Strong; H. C. Trumble and R. E. Shaptor, 1067
Heteroauxin and Cambial Activity, A. B. Brown and R. G. H. Cormack, 898
Hetero-auxin, Effect of, on the growth of Broad Bean Plants in Water Culture, Dr. H. L. Pearse, 26
Heteroauxones in Legume Nodule Formation, Role of, Beneficial Host effects of Nodules and Soil Fertility, Prof. G. K. K. Link, 507
High-frequency Fields, Alleged Specific Effects of, on Biological Substances, Dr. J. B. Bateman, Dr. H. Loewenthal and Dr. H. Rosenberg, 1063
Highway, Modern, Science and the, Dr. B. H. Knight (*Review*), 441
Himalayan, Eastern, Blood-groups, Miss Eileen W. E. Macfarlane, 591
Hippolyte varians, Colour changes in, Dr. L. H. Kleinholz and Dr. J. H. Welsh, 851
Holarctic Fauna and Flora, Evolution of the, Dr. B. P. Uvarov (*Review*), 129
Holarktis, Die, W. F. Reinig (*Review*), 129
Holocentrus, Squirrel Fish, Colour changes due to erythrophores in, G. H. Parker, 83
Horniman Museum, retirement of Dr. H. S. Harrison, 227; Dr. L. W. G. Malcolm appointed curator, 228
Horticultural: Note Book, J. C. Newsham. Fifth impression (*Review*), 527; Practice, The relation of growth substances to, Dr. M. A. H. Tincker, 594
Horticulture": Practical Hints in (*Review*), 527; Recent Advances in, 860; "Scientific, 1937, 860
Hospitals, Reforms in the [1837], 556
House: Plants, R. van Tress, 420; -Rat in the United States, 355
Human: Biology, Need for the Study of, Prof. R. Pearl, 145; Societies, Control in, Prof. J. Dowd (*Review*), 481; Skeletal Remains in London, Dr. A. J. E. Cave, 497; Nature: The Nature of, and other Essays in Social Psychology, Prof. E. Faris (*Review*), 566
Humidity, a Coefficient of, of General Applicability, A. Angström, 160
Hydrangea Flowers, Colour of, E. M. Chenery, 326
Hydro-electric: Practice in India, The, Prof. B. C. Chatterjee. 2 Vols. (*Review*), 442; Power Scheme, A New, in Sweden, 817
Hydrogen: Isotope 2 of, Compounds of the, with the Alkali Metals (alkaline deuterides), L. Hackspill and A. Borocco, 82; Heavy, in Scientific Research, H. S. Taylor (Bruce-Preller lecture), 124; Structure of Hα of, Prof. N. A. Kent, Royal M. Frye and W. H. Robinson, 236; and Helium, Isotopes of, of Mass 3, The search for the, Lord Rutherford, 303; Bridges in Solid Pentaerythritol, I. Nitta and T. Watanabé, 365
Hydroid, A New, from Norway, E. Westblad, 1104
Hydroxy Compounds, Infra-red absorption of, near 3μ, Drs. J. J. Fox and A. E. Martin, 937
Hyla arborea L., Influence of the Central Nervous System on the Adaptation of the Colour of, Martha Geiringer, 41
Hymenoptera Symphyta, Cytology of Parthenogenetic Reproduction of, F. Greenshields (1), 124
Hyperbolic: Space, Dr. G. C. McVittie, 773; or Spherical Space, Dr. G. C. McVittie, 1105
Hypophysis: Morphogenetic Activity of Different Parts of the, A. A. Voitkevič, 599; 821; and the Thyroid Gland, *Posterior Lobe of the*, O. Peczenik and L. Popper, 821;
Hypothesis, Judgment by, Dr. H. Dingle, 589

Iceland, Zoology of, R. Spärck; E. Wesenberg-Lund, 419
Ideology and Utopia: an Introduction to the Sociology of Knowledge, Prof. K. Mannheim (*Review*), 481
Imperial College of Tropical Agriculture, Trinidad, E. Harrison appointed professor of agriculture, 1009
India: The Millipedes of, Dr. C. Attems, 72; British, Public Health in, during 1934, 189; National Institute of Sciences of, grant-in-aid to the, 270; Plant Diseases and Pests, Some of, and their control, A. Mitra, 272; The Law of Trade and Merchandise Marks in, Dr. S. Venkateswaran (*Review*), 342; Trade Marks in (*Review*), 342; Industrial Research in, 352; Survey of, Annual Report for 1936, 460; Meteorological Department, Report for 1935–36, 499; Spirit Drinking in [1837], 556; and Burma, Aquatic and Marsh Plants of, K. P. Biswas, 592; Broadcasting in, 614; Agricultural Meteorology in, 651; Archæological Research and the Pre-history of, 925; National Institute of Sciences, election of fellows, 928; Mails from, [1837], 984
Indian: Ethnography, R. E. Enthoven (*Review*), 213; Institute of Science, Bangalore, Sir C. V. Raman appointed professor of physics, 232; Science Congress Association: Silver Jubilee, 313; Diets, Nutritional Value of some, D. N. Mullick and Dr. J. T. Irving, 319; Institute for Medical Research, Report for 1935–36, 422; Hydro-Electric Technics (*Review*), 442; Coleoptera, Larvæ of, J. C. M. Gardner, 592; Science Congress: The British Association and the, *a scientific delegation to India*, 609; Trees, Some Beautiful, late Rev. E. Blatter and W. S. Millard (*Review*), 633; Science Congress Association, jubilee *meeting of the, Sir James Jeans to preside over the*, 803; Hydro-Electric Development, 841; Sites, Early, in Virginia, U.S.A., D. I. Bushnell, jun., 854; Science Congress, The British Association and the, 921
Indiana. 1: Leben, Glaube und Sprache der Quiché von Guatemala; 2: Mythen in der Muttersprache der Pipil von Izalco in El Salvador (*Review*), 788
Indophenol, Specificity of, in the estimation of Ascorbic Acid in Fermented Products, F. W. Fox and W. Stone, 234
Industrial: Accidents, Scientific Aspects of, 559; Psychology, National Institute of, Work of the, Lord Dudley, 1088
Industry: Research and, 437; Location of, H. C. Emmerson and others, 515; in Great Britain, Location of, 1075
Infant Speech: a Study of the beginnings of Language, M. M. Lewis (*Review*), 172
Inflammable Gas in a Fire, Behaviour of Cylinders of, Dr. O. C. de C. Ellis, 935
Inland Water Survey: Committee: Second Annual Report, 1936–37, 1106; in Great Britain, Dr. B. Cunningham, 1106
Insanity, Civilization and [1837], 693
Insects: present-day, Ancestors of some groups of the, Prof. G. Zalessky, 847; and Mites of Stored Grain, *R. T. Cotton and N. E. Good*, 936
Insolation and Relief, Miss A. Garnett, 776
Institute of Patentees, Dr. S. C. Blacktin awarded the *silver medal of the, and the Founder's silver medal*, 1058
Insulin: The Two Crystalline Modifications of, Dr. D. Crowfoot, 149; Structure of, Cyclol Theory of the, Dr. Dorothy M. Wrinch, 286; Protamine, Use of, 315; Early work on, Sir Frederick Banting, 901
Integrative Levels: a Revaluation of the Idea of Progress, Dr. J. Needham (Herbert Spencer lecture), 679
Intellectual: Co-operation and International Science, 121 Unemployed in France, Aid for, 612

Intelligence and Civilization, Prof. G. H. Thomson (Ludwig Mond lecture), 59

Intensities, Law for Minimal Discrimination of, A. H. Holway and W. J. Crozier (2), 943

International: Co-operation in Social and Economic Problems, 1; Congress of Agriculture, Seventeenth, at the Hague, 35; Geodesy, Development in, Dr. J. de Graaff Hunter, 75; Union of Biological Sciences, next general assembly of the, 147; Tin Research and Development Council, Statistical Year Book, 1937, of the (*Review*), 176; Agreement for the Regulation of Whaling, 180; Association for European Ethnology and Folklore: Conference at Edinburgh, 206; Grassland Congress, Fourth, 248; Dr. D. S. Huizinga elected president of the fifth congress, 249; Co-operation in Science, 337; Acoustical Conference, First, 370; Congress for Short Waves in Physics, Biology and Medicine, Vienna, Dr. J. B. Bateman, 372; Population Congress in Paris, 471; Society of Leather Trades' Chemists: Conference at Copenhagen, 516; Council of Scientific Unions, Prof. J. Sakurai elected vice-president of the, 641; Geological Congress, The Seventeenth, Prof. W. T. Gordon, 789; Conference of Genetics, Eighth, 803; Conference on the Theory of Probability, Prof. E. L. Dodd and J. Neyman, 938

Inventions, New, Exhibition, Dr. S. C. Blacktin, 982

Iodine: Value of Drying Oils, Variation of the, according to their origin, P. Balavoine, 125; Vapour, Some Electrical and Optical properties of, Prof. K. G. Emeléus, E. B. Cathcart and C. M. Minnis, 251; Diamagnetism of Solutions of, and the Purity of the Alcohol, C. Courty, 518; Electrode, Potential of the, R. G. Bates and W. C. Vosburgh, 776; Prof. Irvine Masson, 1005

Iodoacetate, Action of, on Dehydrogenases and Alcoholic Fermentation, Dr. W. M. Dixon, 806

Ion UO_2++, Thermomagnetic Properties and Constant Paramagnetism of the, in Some Uranyl Salts in Aqueous Solution, A. Nicolau, 985

Ionic: Mobilities, Effect of Viscosity on, D. Belcher, 810; Clouds, Irregular, in the *E* Layer of the Ionosphere, T. L. Eckersley, 846

Ionization: Theory and Radiobiological Phenomena, C. E. Nurnberger, 83; by Radioactive Gamma and Cosmic Rays in different Gases, J. Juilfs, 767

Ionosphere: Artificial, Anomalous Dielectric Constant of, Prof. S. K. Mitra and K. K. Roy, 586; 1066; Ionization of Lower Part of, Mme. Irène Mihul and Constantin Mihul, 694; Disturbances, Dr. J. H. Dellinger, 732; Observations in Japan during a Solar Eclipse, T. Minohara and Y. Ito, 814; *E* Layer of the, Irregular Ionic Clouds in the, T. L. Eckersley, 846; Wireless Waves in the, Annual Variation of the Absorption of, Dr. F. W. G. White and L. W. Brown, 931

Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions, Dr. D. F. Martyn and G. H. Munro, A. J. Higgs and Dr. S. E. Williams, 603; Disturbances, Catastrophic, An Effect of, on Low frequency Radio Waves, K. G. Budden and J. A. Ratcliffe, 1060

Ions: Slow Positive, Diffraction of, A. G. Emslie, 463; Negative, in Discharge Tubes, Dr. K. G. Emeléus and J. Sayers, 1111

Iran, Exploration in (*Review*), 523

Iraq, Early Sculpture from, Sidney Smith, 647

Ireland: The Peasant Farmers of (*Review*), 299; Archæological Investigations in, 720

Irish: Countryman: The, an Anthropological Study, Dr. C. M. Arensberg (*Review*), 299; Pilgrimage An (*Review*), 870

Iron: and Steel Institute, Prof. L. Guillet nominated an honorary vice-president of the, 104; Passivity of, W. H. Cone and H. V. Tartar, 117; and Steel Industry, Research in the, 353

Isotopes: of Hydrogen and Helium of Mass 3, The Search for the, Lord Rutherford, 303; of Strontium, 475

Italy, Artificial Wool Production in, 1090

Jamaica, Flora of, W. Fawcett and Dr. A. B. Rendle Vol. 7, late S. Le Marchant Moore and Dr. A. B. Rendle (*Review*), 302

Japan: Astronomy in, 60; Decapod Crustacea of, Z. I. Kobjakova, 72; Western Science in, Beginnings of, Prof. J. Sakurai, 205; Crust Displacements in, Prof. N. Miyabe, 776; Earthquake Swarm of Itô, F. Kishinouye, 977

Japanese: Trawlers in Indian Waters, 270; Slugs, Self-Fertilization of, K. Ikeda, 591

Jenkins, Rhys, The Collected Papers of (*Review*), 301

Jersey, Geology of, 249

Jerusalem: Hebrew University of, Appeal for funds, 231; Roman, 578

Jews in Poland, 925

Joule-Thomson Effect and Quantum Statistics, Dr. D. S. Kothari and B. N. Srivasava, 970

Julaber's Grave, Kent, Excavation of, 228

Jupiter's Atmosphere, Physical State of, B. M. Peek, 776

Jute, Trisomic Mutations in, Dr. H. K. Nandi, 973

Kaiser Wilhelm Society for the Advancement of Science, Prof. C. Bosch elected president of the, 274

Kansas, Permian Rocks of, Fossil Insects from the, late Dr. R. J. Tillyard, 116; 1018; 1104

Kashmir Earthquake of November 14, 886

Katalytische Umsetzungen in homogenen und enzymatischen Systemen, Dr. W. Frankenburger (*Review*), 827

Kelvin and the Atomic Theory, C. Turnbull, 888

Ketene, Preparation of, Products formed during the, R. W. Hale, 1017

Ketones, Aldehydes and, Photo-decomposition of, Prof. R. G. W. Norrish and C. H. Bamford, 195

Kew Gardens [1837], 777

Khāriās, The, Sarat Chandra Roy and Ramesh Chandra Roy. 2 Vols. (*Review*), 213

Kidney: Influence of Temperature on the Activity of the, in relation to its influence on Oxygen Consumption. Prof. E. J. Conway, J. M. O'Connor and D. K. O'Donovan, 40; Mammalian, Structural Laws of the, with Theoretical Derivations, Prof. E. J. Conway, 40

Kiel University, Dr. W. Kuhn appointed professor of physical chemistry in, 358

Kinematography, Fifth Annual Exhibition of, 964

Kineses, Taxes and, Classification of, Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou, 1064

Komodo 'Dragons' at Edinburgh Zoological Park, 721

Krypton and Xenon, Packing Fractions of, Dr. F. W. Aston, 149

Kxatla Culture, Modern, Contributions of Western Civilization to, Prof. I. Schapera, 16

L α Emission Lines of Cu and Fe, Intensity and Structure Changes of the, on intense Cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464

L-Emission Bands of Zinc, Copper, Nickel and Cobalt, Dr. J. Farineau, 508

Li+ and He, Ionization Energy of, H. A. S. Eriksson, 151

Labour, Displacement of, by Machinery, H. D. Henderson, 679

Lac in Malaya, N. C. E. Miller, 510

Lactoflavin: in Milk, Determination of, C. H. Whitnah, B. L. Kunerth and M. M. Kramer, 430; The Coulter Compound, 'Cytochrome *b*', and Cytochrome *c*, Spectroscopic observations of reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466

Lake District as a National Park, The, 423

Lamellibranch Gills, Ciliary Currents in, A. Graham, 687

Land: Drainage: Act, 1930, Report on, 823; in England and Wales, 823; Speed Record, New World, Capt. G. E. T. Eyston, 929; for the People (*Review*), 1031

Langmuir-Blodgett Films of Stearic Acid, Structure of, L. H. Germer and K. H. Storks, 779

Language in Europe: Borderlands of, and their Relation to the Historic Frontier of Christendom, Dr. Vaughan Cornish (*Review*), 994

Lankester, Ray, Investigator, at Plymouth, Dr. S. Ochoa appointed, 190

Lantern Slides, German and British, 718

Larvæ in Timber, Destructive, Detection of, Dr. R. L. Smith-Rose, 512

Latin Clarity and the Sciences of Life, Dr. J. Needham (*Review*), 664

Lead: Borates, R. F. Geller and E. N. Bunting, 34; A New Oxide of, C. Holtermann and P. Laffitte, 293; Crystal Growths in Silica Gel, Spiriform Morphology of some, N. Stuart, 589; Ores, Origin of, Prof. A. Holmes, 937

League of Nations, Health Committee of the, Dr. T. Madsen re-elected president of the, 315

Learning, The Higher, Dr. R. C. Wallace, 541

Leather Trades' Chemists: International Society of, Conference at Copenhagen, 516

Lebistes, Succession Broods of, G. L. Purser, 155; Dr. Ö. Winge, 467

Lecithin, Yolk, Origin of, L. Hahn and Prof. G. Hevesy, 1059

Lecithinæmia following the Administration of Fat, Prof. G. Hevesy and E. Lundsgaard, 275

Leeds University: endowment of the Clive Behrens lectureship, Hon. Mrs. Behrens, 166; conferment of title of emeritus professor on Dr. G. W. Watson, 778; scheme for promotion of physical fitness, 886; Dr. J. W. Orr elected reader in experimental pathology; Dr. H. G. Garland appointed clinical lecturer in medicine and honorary demonstrator in medical pathology, Dr. J. A. Price honorary demonstrator in medicine, N. Lissimore honorary demonstrator in pathology, F. R. W. Hemsley and I. J. Keidan honorary demonstrators in anatomy and Miss Florence O. Bell research assistant in textile physics, 942

Legendre Functions, Zeros of, P. G. Gormley, 81

Légion d'Honneur, La Croix de Chevalier de la, conferment of, on G. E. Pearson, 315

Legumes and Non-legumes, Associated growth of, A. I. Virtanen, 248

Leicester, Roman, Excavation of, 229

Leisure: Utilization of, Survey on the, 229; The Problem of, 941

Lemna minor, A Short Periodic Growth Cycle and a Secular Variation in, H. Dickson, 112

Leopold, Order of, Profs. J. Bordet and P. Nolf awarded the Grand Cross of the, 104

Lepidosiren, Cytology of, Prof. W. E. Agar, 931; Prof. E. W. MacBride, 932

Leukæmia in Mice, Inheritance of, Dr. E. C. MacDowell, 368

Leverhulme Research Fellowships, and Research Grants, award of, 102

Leviathan, The (*Review*), 911

Lhuyd's Maps of England and Wales, Dr. F. J. North, 813

Lichens found in Ireland—Chemical Constituents of: *Pertusaria concreta*, J. Breen, J. Keane and T. J. Nolan, 333; *Parmelia conspersa*, Ach, Margaret Mohan, J. Keane and T. J. Nolan, 376

Life: Here and Now: Conclusions derived from an Examination of the Sense of Duration, Arthur Ponsonby (Lord Ponsonby of Shulbrede), (*Review*), 341; Reflections on, R. Brightman (*Review*), 341; The Little Things in, the Vitamins, Hormones and other minute Essentials for Health, Prof. B. Sure (*Review*), 829

Light: the Neutrino Theory of, V. Fock, 113; Anomalies of the Dispersion of, by Colloidal solutions of Silver, C. Jausseran, 209; Depolarization of, diffused by Argon, New Measurements of the Factor of, A. Rousset, 251; thought to have been seen in the neighbourhood of Alternate Current Magnets, The, Lord Rayleigh, 423; in the Service of Man, Prof. N. R. Dhar (*Review*), 444; Sources, High Intensity, Dr. J. A. V. Fairbrother, 562; Neutrino Theory of, in Three Dimensions, A. Sokolow, 810; Diffraction of, by Ultrasonics at Oblique Incidence, Dr. F. Levi, 969

Lighting: Appraisement of, Dr. C. C. Paterson (Guthrie lecture), 763; in Factories and Workshops, Appointment of a committee on, 845; Public, Control of, 1090

Lightning: Discharges, Effect of near, on a Magnetometer, Dr. K. R. Ramanathan, 587; Ball, A Theory of, T. Neugebauer, 814

Lilium Harrisii, Bud Development in, following treatment with Indoleacetic Acid, J. M. Beal, 519

Linear Operators: The Theory of, from the Standpoint of Differential Equations of Infinite Order, H. T. Davis (*Review*), 174

Linguistics, Contemporary, The Dilemma of, Prof. B. Malinowski (*Review*), 172

Lipids, The Biochemistry of the, Dr. H. B. Bull (*Review*), 787

Liquid: Drops at Interfaces, Visible Adsorbed Films and the Spreading of, Prof. D. H. Bangham, S. Mosallam and Z. Saweris, 237; Hydrocarbons, Light, Products Formed by the Incomplete Combustion of, A. Maillard and R. Friedrich, 985

Liquids, Natural Convection in, M. Atanasiu, 985

Lister Institute of Preventive Medicine, Forty-third annual report, 766

Liver, Fatty, Action of Pancreatic Extract on, B. Shapiro and Prof. E. Wertheimer, 771

Liverpool Naturalists' Field Club, Seventy-sixth annual proceedings of the, 357

Liverpool, S.S., Launch of [1837], 693

Living World, The (*Review*), 484

Lockyer, Norman, Observatory, Annual Report, 1936–37, 965

Locust Outbreak in Africa and Western Asia, Fifth survey of the, Dr. B. P. Uvarov and Miss W. Milnthorpe, 33

Locusts in the Field, Phase Transformation in, J. S. Kennedy, 889

Logic and Empiricism, Dr. T. Greenwood (*Review*), 866

Lomonosov and Early Science in Russia, S. S. Ivanoff (*Review*), 784

Lomonosova, Trudy M. V., po Fisike i Chimii, Prof. B. N. Menshutkin (*Review*), 784

London: Electrical Society [1837], 208; University: award of postgraduate studentships; J. P. Quilliam awarded a university studentship in physiology; O. A. Saunders appointed Clothworkers' reader in applied thermodynamics at the Imperial College—City and Guilds College, 38; A. A. Miles appointed professor of bacteriology at University College Hospital Medical School and Prof. J. H. Dible professor of pathology at the British Postgraduate Medical School, 166; Sir Robert Pickard elected vice-chancellor and Prof. J. C. Philip deputy vice-chancellor; Dr. W. Wardlaw appointed professor of physical chemistry at Birkbeck College; conferment of title of professor on Dr. G. R. Cameron and that of reader on H. Torrey, 207; T. C. Stamp appointed reader in bacteriology at the British Postgraduate Medical School; Dr. A. R. Todd appointed reader in biochemistry at the Lister Institute of Preventive Medicine; conferment of the title of reader in zoology on H. R. Hewer and that of emeritus professor on Prof. H. V. Blackman; gift by A. Chester Beatty for a scholarship in radiology, 778; conferment of an honorary doctorate on the Queen, 862; J. D. Bernal appointed professor of physics at Birkbeck College, 904; Prof. A. J. Allmand appointed Daniell professor of chemistry at King's College, Dr. L. P. Garrod reader in bacteriology at St. Bartholomew's Hospital Medical College, Dr. C. F. Goodeve reader in chemistry, C. W. Dannatt reader in metallurgy at the Imperial College—Royal School of Mines and Dr. H. J. T. Ellingham reader in physical chemistry at the Imperial College of Science and Technology, 942; College: Prof. J. B. S. Haldane first holder of the chair of biometry, 612; Prof. S. Sugden appointed professor of chemistry and Prof. C. K. Ingold director of the Chemistry Laboratories, 654; conferment

upon Prof. T. Yeates, of the title of emeritus professor, 1026; New buildings for, 1088; conferment of the title of reader in civil engineering on Dr. A. L. Higgins, and that of emeritus professor of chemistry on Prof. F. G. Donnan; award of a doctorate on Miss Katherine Warington and Miss Katherine Tansley, 1110; College, Extension of Buildings, 964; Mathematical Society, election of officers, 1094
Long Ashton Research Station, Annual Report for 1936, 861; Barrow, Origin of the, S. Piggott, 1103
Longitudes, An Annual Change in, Dr. F. Schlesinger, 1068
Loris: a Journal of Ceylon Wild Life, 720
Louse, Biting, Distribution of the, N. J. B. Plomley and G. B. Thompson, 199
Low-Temperature Thermostat, An inexpensive, L. C. Beadle and F. A. Booth, 279
Lubrication and Lubricants, 815; 859
Lubricants, Lubrication and, 815; 859
Lyell: in Germany [1837], 375; to Leonard Horner [1837], 517
Lymnæa, *Drosophila* and, Temperature and the Growth of, T. Imai, 1067
Lysozyme, Crystallization of, E. P. Abraham and Prof. R. Robinson, 24

M-Emission Bands of Zinc, Copper and Nickel, Dr. H. W. B. Skinner and J. E. Johnston, 508
Mackintosh, Dr. John [1837], 736
Magma, Das, und seine Produkte. Teil 1: Physikalisch-chemische Grundlagen, Prof. P. Niggli (*Review*), 913
Magmatic Differentiation, Dr. C. N. Fenner, 327
Magnetic: Declination at Cracow during the period 1914–36, A. Kania, 335; Storms: Cosmic Rays and, Prof. S. Chapman, 423; Variations of Cosmic Ray Intensity during, Prof. C. Störmer, 549; Permeability, Effect of Surface Treatment on, Dr. T. F. Wall, 856; Observations in America [1837], 904
Magnesium: Alloys, H. Endô and S. Morioka, 978; Chloride with Oxygenated Organic Compounds, Classification into two Groups of the Complex Compounds of, According to the Nature of the Oxygen Linkage, Mlle. Marie Louise Quinet, 985
Magneto-Electric Currents [1837], 250
Magnetostriction, Dr. Y. Masiyama, 552; W. Alexander and J. Swaffield, 1068
Maiden Castle, Dorchester: Excavations in 1937, 186; Discoveries at, 677
Malaya: Forestry Research in, 1091; Rubber Research Institute, Report for 1936, 1093
Malayan Agriculture, An Outline of, D. H. Grist (*Review*), 7
Mammals: and Man in America, Extinct, J. H. Cotter, 243; of Ireland, C. B. Moffat, 292
Man: and the Machine Age, Prof. A. Meusel (*Review*), 45; and his Work, Museum Study of, de La Valette, 1108
Manchester University: Prof. F. Wood Jones appointed professor of anatomy in, 15; A. D. Ritchie appointed Sir Samuel Hall professor of philosophy and public administration, Prof. P. M. S. Blackett, Langworthy professor of physics, H. Davenport, P. Du Val and W. W. Sawyer, assistant lecturers in mathematics, G. D. Rochester, assistant lecturer in physics, D. G. Evans, assistant lecturer in chemistry, E. L. Patterson, assistant lecturer in anatomy and Miss Margaret I. Williams assistant lecturer in applied physiology, 207; Scientists' Peace Association, Address to, by Prof. H. Levy, 1055
Marconi: the Man and his Wireless, O. E. Dunlap, jun. (*Review*), 260; Guglielmo, and the Development of Radio Communication, Sir Ambrose Fleming, 963; School of Wireless Communication, 1005
Marine: Engineering, Progress of, S. J. Pigott, 539; Engineering and, Exhibition at Olympia, 553; Eggs, Action of certain Substituted Phenols on, in relation to their Dissociation, A. Tyler and N. H. Horowitz, 779
Marketing, Electricity and, F. H. Slade, 311
Marriage Manual: A, a Practical Guide-book to Sex and Marriage, Dr. Hannah M. Stone and Dr. Abraham Stone (*Review*), 445
Mars and Venus, Occultations of, 103
Marum, Martin Van (1750–1837), 1110
Marvels: A Book of, Lt.-Comdr. R. T. Gould (*Review*), 87; An Inquiry into, Surgeon Rear-Admiral C. M. Beadnell (*Review*), 87
Maryland, Structural Geology of, 1019
Mass: -Observation: C. Madge, 229; C. Madge and T. Harrison, 843; Spectograph, second-order focusing and Isotopic Weights by the Doublet Method, Dr. F. W. Aston, 905
Materie und Strahlung (Korpuskel und Feld), Prof. L. Hopf (*Review*), 386
Maternal Mortality, Reports on, 1093
Mathematical: Analysis, Operational Symbolism in (*Review*), 174; Analysis, The Elements of, Prof. J. H. Michell and M. H. Belz. 2 Vols. (*Review*), 631
Mathematics: Higher School Revision, L. Crosland (*Review*), 7; Practical, Studies in, A. C. Aitken (2), 124; Elementary, History of (*Review*), 255; Men of, Prof. E. T. Bell (*Review*), 525; Teaching of, Discussion on the, 555; Higher, Aspects of (*Review*), 950
Mathematik, Elementar-, Geschichte der, in systematischer Darstellung, Dr. J. Tropfke. Band 3. Dritte Auflage (*Review*), 255
Matter in Space, Distribution of, Observational Evidence for the, J. H. Reynolds, 387
Mauritius, Atmospheric Pressure at, M. Herchenroder, 855
Maxwell's, Clerk, Electric Ideas, Origins of, 614
Meare, Somerset, Recent Excavation at, 498
Mechanistic Biology and Animal Behaviour, T. H. Savory (*Review*), 49
Mechanization in the Modern World, 498
Medal Striking [1837], 556
Medical: Research Council, W. M. Goodenough appointed a member and treasurer of the, 21; Science, Advancement of [1837], 80; Education, Some thoughts on, Prof. R. J. Johnstone, 186; Research Council: Prof. L. J. Witts and Prof. G. E. Gask appointed members of the, 190; award of fellowships to Dr. F. Hawking, D. A. Cannon, L. J. Dales and I. M. MacKichan, 274; Treatment, Modern, Essentials of, Dr. V. Norman (*Review*), 486; Research, A Weakness of, Dr. W. P. Murphy, 901
Medicine: Stamp Duties, Report on, 17; Modern, the Development of, an Interpretation of the Social and Scientific Factors involved, Prof. R. H. Shryock (*Review*), 386; Quack, [1837], 1110
Medizinisch-naturphilosophischen Aphorismen und Kommentare des Magister Urso Salernitanus, Die. Nach Handschriften Lateinisch und Deutsch herausgegeben von Dr. R. Creutz (*Review*), 386
Meiosis and Mitosis, Artificial Release of Crossing-over in, Prof. H. Friesen, 362
Melanin in Fishes, Some Quantitative Relations between visual stimuli and the Production or Destruction of, F. B. Sumner and P. Doudoroff, 83
Melbourne University Medical School, Gift to, 1057
Mellon Institute, Pittsburgh, Dedication of the new building of, 901
Men and Mathematicians (*Review*), 525
Mendel, Morgan and Genetics, Prof. E. W. MacBride, 348
Mendeléeff Centenary in Russia, Epilogue to the (*Review*), 90
Mendeléev, Congrès Jubilaire, Travaux du. 2 Vols. (*Review*), 90
Mental: Disease, Birmingham Joint Board of Research for, Annual Report for 1936–37, 314; Factors, Selection and, Dr. G. H. Thomson, 934; Disturbances, Physiological Patterns and, J. W. Thompson, W. Corwin and J. H. Aste-Salazar, 1062
Mercurous Perchlorate as a Volumetric Reagent for Chlorides and Bromides, W. Pugh, 656
Merino: Australian, The Evolution of the, E. W. Cox (*Review*), 870; Trio Follicles in the, Non-specificity of the, Dr. A. B. Wildman, 891

Mesolithic Site in Surrey, Excavation of a, Dr. J. G. D. Clark, 144
Mesothorium-I, Concentration of, by Duckweed (*Lemna*), Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunasheva, 317
Messianic Radiation (*Review*), 171
Metabolism, Body-size and, Relation between, C. Ellenby, 853
Metal: Films, Thin, Structure and Resistance of, D. A. Wright, 107; -Ammonia Ions, Prof. A. A. Grünberg, 422; -Spraying, R. R. Sillifant, 1105
Metallic: Corrosion, Passivity and Protection, Dr. U. R. Evans (*Review*), 629; Aluminium, Determination of Alumina in, G. B. Brooke and A. G. Waddington, 858
Metalle, Elektronentheorie der, Dr. H. Fröhlich (*Review*), 953
Metallurgy and the Aero Engine, Dr. D. R. Pye, 516
Metals: Institute of, Journal of the. Vol. 59. Edited by G. Shaw Scott (*Review*), 176; Hardness of, Dr. F. C. Lea (*Review*), 260; Rigidity of, Effect of Occluded Hydrogen on the, Father Joseph Lynch, 363; Oxide Film Formation on, Polarimetric studies of, A. B. Winterbottom, 364; Gases and, an Introduction to the study of Gas-Metal Equilibria, Dr. C. J. Smithells (*Review*), 385; of Hexagonal Structure, Asymmetry in, Dr. G. W. Brindley and P. Ridley, 461; Corrosion of (*Review*), 629; The Theory of, based on an Essay awarded the Adams prize in the University of Cambridge, 1931–1932, A. H. Wilson (*Review*), 702; and Alloys, Studies of, 857; Ferromagnetic, The Paramagnetic Magneton Numbers of the, Prof. W. Sucksmith and R. R. Pearce, 970; Structure of, Dr. A. Müller, 1011
Metaphosphoric Acid, Proteins and, Reactions between, Dr. H. Herrmann and G. Perlmann, 807
Meteor, Bright, of November 9, A. E. Moon, 1102
Meteoric Shower, Tenham, of 1879, Dr. L. J. Spencer, 369
Meteorite Craters, 801
Meteorites: the number of Pultusk Stones, and the spelling of "Widmanstätten Figures", Prof. F. A. Paneth, 504, 809; Dr. L. J. Spencer, 589; of the Gran Chaco, 1006
Meteorological Elements, Monthly, 146
Meteorology: of Great Floods in the Eastern United States, C. F. Brooks and A. H. Tiessen, 511; Agricultural, in India, 651; in the Navy, 1057
Meteors: Orionid, Observation of, 928; 1009
Methyl Halides, Carbon-Halogen Distance in the, Dr. G. B. B. M. Sutherland, 239
Metric System and British Export Trade, Rev. A. J. Stubbs; Sir Isidore Salmon, 1089
Mexico, New, North-Eastern, Prehistoric Archæology of, Prof. E. B. Renaud, 72
Mice: Sensitization of the Skin of, to Light by Carcinogenic Agents, Dr. I. Doniach and Dr. J. C. Mottram, 588; Male, Production of Sterility in, by Irradiation with Neutrons, G. N. Snell and P. C. Aebersold, 779
Microbial: Suspension, Rapid Counting of a, G. Carrisson, 376; Broths, Absorption Spectra of, J. Debiasse, 985
Microscopy: The Quekett Microscopical Club, 273
Midlands, West, The Pleistocene History of the, Prof. L. J. Wills, 995, 1036
Migrations, A Compilation on, Prof. C. Daryll Forde (*Review*), 89
Milk: Nutritive: Qualities of, Effect of Pasteurization of the, 115; Value of, Influence of Pasteurization in the absence of air on the, H. Simonnet, G. Guittonneau, G. Mocquot and A. Eyrard, 209; Supply and National Health, 295; Off-flavoured, Acidosis and, Capt. H. Barkworth and L. W. L. Cole, 324; Pasteurized, The Nutritive Value of, 389; Clean, and Pasteurization, Dr. G. Arbour-Stephens, 614
Mind: In the Realm of, Dr. C. S. Myers (*Review*), 705
Mineral: Position of the British Empire, 285; Wealth, The Empire's, 801
Mineralogical Society, election of officers, 888
Minerals: Atomic Structure of, Prof. W. L. Bragg (George Fisher Baker lecture) (*Review*), 783; Field Tests for, E. H. Davison (*Review*), 830
Mining Engineers, Institution of, award of medals to Dr. C. Beyling and Prof. R. V. Wheeler, 967
"Minnesota: Man", Prof. A. E. Jenks, 578; Dr. A. Hrdlička, 1103; Fossil Man in, 596; Pleistocene Man in, a Fossil Homo Sapiens, Dr. A. E. Jenks. With a chapter on the Pleistocene Geology of the Prairie Lake Region, by Dr. G. A. Thiel, 596
Minos, Palace of, Index to the, Dr. Joan Evans. With special sections classified in detail and chronologically arranged, by Sir Arthur Evans (*Review*), 486
Mitogenetic: Analysis of the excitation of the Nervous System, Prof. A. G. Gurwitsch (*Review*), 565; Radiation and the Theory of Nerve Excitation, Dr. J. B. Bateman (*Review*), 565; Rays? A. Hollaender and W. D. Claus, 1007
Mitosis, Meiosis and, Artificial release of Crossing-over in, Prof. H. Friesen, 362
Mitotic Spindle, Self-arrangement in the, under Mechanical Influence, Dr. H. H. Pfeiffer, 770
Moeurs et coutumes des indiens sauvages de l'Amérique du sud, Marquis de Wavrin (*Review*), 344
Moine Schists, Petrofabric Study of, F. C. Cole, 429
Molecular: Films, Built-up, K. B. Blodgett and Dr. I. Langmuir, 470; Compounds, Organic, Structure of, Dr. J. S. Anderson, 583; Structure, Force Constants and, Dr. H. W. Thompson and J. W. Linnett, 1065
Molecules, Large, The Synthesis of, Prof. H. Mark, 8
Molge cristata Laur., Local Transformation of Solid and Hollow Bones of, O. Hrabik, 1074
Mollusca, Fresh Water, Development of Teeth in the Radula of, F. G. Cawston, 1028
Molluscs, Polyplacophoran, Digestion in, Vera Fretter, 976
Molybdenum: Blues, V. Auger and Mlle. Nina Ivanoff, 293; Tellurium, Tungsten and, Hexaco-ordination of, J. Gupta, 685
Molybdotartaric Complex Compounds in Water, Two, Study by the Raman Effect of, Mlle. Marie Théodoresco, 209
Mongalla Province, A Tribal Survey of. Edited by L. F. Nalder (*Review*), 632
Mongolian Fungus, An edible, 'pai-mo-ku', S. Imai, 695
Monkeys: Longevity of, Prof. W. C. Osman Hill, 72; and Man, Embryonic, Prof. W. C. Osman Hill, 115
Monomolecular Films: E. Havanga and J. de Wael, 160; Viscosity of, Prof. W. D. Harkins and R. J. Myers, 465
Moon's Equatorial Horizontal Parallax [1837], 819
Morgan, Mendel and Genetics, Prof. E. W. MacBride, 348
Morse Recording Electric Telegraph [1837], 597
Mortality, Selective Action of, Prof. F. A. E. Crew, 410
Mosses, Submerged, River Liffey, Chironomid Fauna of the, C. F. Humphries and Winifred E. Frost, 976
Motor: -Car Engine Cylinders, Wear of, 147; -Boat Speed Record, Sir Malcolm Campbell, 460; -Car Headlights, Coloured Light for, 679
Mould and Bacteria Killed by New Lamp, 844
Mountains of the Moon: an Expedition to the Equatorial Mountains of Africa, P. M. Synge (*Review*), 951
Mud: Fluid for Pressure Drilling Conditions, Dr. J. T. Evans, 202; Drilling, P. Evans and A. Reid, 1025
Museum Collections, Improvement of, Dr. W. E. Swinton, 734
Museums: Association, Annual Conference of the, Presidential Address by Alderman C. Squire, 164; Empire grants committee for, 499; and the People, 734
Mushet's Discovery of Blackband Ironstone [1837], 80
Music: Physics of (*Review*), 947; and Sound, Ll. S. Lloyd (*Review*), 947; Science and, Sir James Jeans (*Review*), 947
Mysidacid Crustaceans, New Species of, Prof. W. M. Tattersall, 775
Mysticism, Theory and Art of, Prof. R. Mukerjee (*Review*), 636
Mytilus, Miss Kathleen M. White (*Review*), 633
Myxobacteria—The, Cellulose-degrading Agents, Mme. H Krzemieniewska and S. Krzemieniewski, 187

Nα+++ Ion, Decomposition of the Ground Term of, Absorption spectra evidence of the, due to Crystalline Fields, Prof. D. M. Bose; Dr. W. G. Penney and G. J. Kynch, 109

National: Physical Laboratory, Inspection by the General Board, 36; Institute for Research in Dairying, Dr. G. W. Scott Blair appointed head of the chemistry department of the, 61; Museums of Natural History, F. Chapman, 272; Health, Milk Supply and, 295; *Fitness: the First Steps* (*Review*), 561; Research Council, gift to the, by the John and Mary R. Markle Foundation of New York, 582; Institute of Agricultural Botany, Value of System of substations of the, Capt. D. M. Wills, 843

Nation's Intelligence, The, J. L. Gray (*Review*), 528

Nature: the Mechanism of, being a Simple Approach to Modern Views on the structure of Matter and Radiation, Prof. E. N. da C. Andrade. Revised and enlarged edition (*Review*), 260; Photography: Thirty years of, a Personal Record of two observers, Seton Gordon (*Review*), 302

Natural History: Outlook, Prof. J. Ritchie, 417; *in the* Schools, 421

Nauka Polska. Tom (Vol.) 22 (*Review*), 133

Naval: Architects, Institution of, award of the Sir William White postgraduate scholarship to A. M. Baxter, 422; Architecture and Engineering, 597; Architects, Institution of, award of scholarships to S. F. Rice, A. Silberblatt and P. Martin, 722

Navy: Engineering Progress in the, Prof. C. J. Hawkes, 1024; Meteorology in the. 1057

Neanderthal Tooth, A Lost, 961

Nebulæ: in Pisces, A New Cluster of, F. Zwicky, 293; Red Shifts and the Distribution of the, Dr. E. Hubble, 649

Nematodes: Parasitic in Animals, Dr. G. Lapage (*Review*), 526; Physiology of, D. G. Davey, 645; of Horses and Sheep, Control of, I. W. Parnell, 686

Neodymium Acetylacetonate, Influence of the Solvent on the Absorption Spectra of, Mlle. Milka Radoïtchitch, 81; Atomic Weight of, Hönigschmid, 1104

Neural Induction: by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the Ectoderm of the Anuran Gastrula, Prof. G. A. Schmidt, 199; by Plant Tissues in the Ectoderm of the Gastrula of *Triton taeniatus*, M. N. Ragozina, 199

Neutrino: Theory of Light, The, V. Fock, 113; Shower, β-Decay as due to a, N. S. Nagendra Nath, 278; Theory of Light in Three Dimensions, A. Sokolow, 810

Neutron: Beams, Polarized, A Method of obtaining, Dr. H. v. Halban, jun., 425; Levels, Resonance, of Silver, Rhodium and Bromine Nuclei, Spacing of the, C. Y. Chao and T. H. Wang, 768

Neutrons: Production of Mutations by, Mary Nagai and G. L. Locher, 111; from Lead, Expulsion of, by Cosmic Rays, B. Arakatsu, K. Kimura and Y. Uemura, 277; inside Magnetized Iron, The Magnetic Field acting upon, Dr. O. R. Frisch, Dr. H. von Halban, jun. and Dr. J. Koch, 360; Slow, in Light Elements, Capture of, Dr. O. R. Frisch, Dr. H. von Halban, jun. and Dr. J. Koch, 895

Newcomen Society, Annual General Meeting; Eng.-Capt. E. C. Smith elected president, 964

Newfoundland Amphipoda and Decapod Larvæ, Miss Nancy Frost, 898

New York Botanical Garden, Journal of the, Papers by Dr. J. K. Small, 274

New Zealand: Fish Oils, F. B. Shorland, 223; Australia and, Science in, 231

Nickel: Wire, Magnetic quality of, as influenced by the Surface, Dr. T. F. Wall, 238; Cementation of, by Beryllium, J. Laissus, 251

Nicotinic Acid and the Pellagra-Preventing Vitamin, Dr. L. Harris, 1070

Nigeria, Indirect Rule in, R. S. Rattray (*Review*), 826

Nigerian Tribe: Law and Authority in a, a Study in Indirect Rule, Dr. C. K. Meek (*Review*), 826

Night Sky: in August, 190; in September, 358; *in* October, 581; in November, 766; in December, 929

Nile, Dry-crossing of the, E. J. Wayland, 811

Nitric: Oxide: and Alkyl Ethers, Prof. M. W. Travers, 107; NO, Magnetic Rotatory Power of Compressed and of Liquefied, H. Bizette and B. Tsai, 208; Acid, Reduction of, to Hydroxylamine by the Higher Plants, M. Lemoigne, P. Monguillon and R. Desveaux, 293

Nitrogen: Organic Chemistry of, Prof. N. V. Sidgwick. New edition, revised and rewritten by T. W. J. Taylor and Dr. W. Baker (*Review*), 4; Excretion of, by Leguminous Plants, Prof. P. W. Wilson, 154; Heavy, Prof. H. C. Urey, 496; Isotope, Concentration of, Prof. H. C. Urey, M. Fox, J. R. Huffman and H. G. Thode, 512; Excretion of, by Leguminous Plants, Prof. A. I. Virtanen; Dr. G. Bond, 683; Spectrum of, and Atmospheric Pressure at High Altitudes, R. Bernard, 930; Fixation, Symbiotic Mechanism of, P. W. Wilson and, E. B. Fred (2), 943

Nobel: prize for medicine, award of the, to Prof. A. von Szent-Györgyi, 798; prizes: award for physics to Dr. C. J. Davisson and Prof. G. P. Thomson and for chemistry to Prof. W. N. Haworth and Prof. P. Karrer, 882

Nocht, Bernard, Medal, awards of the, 1009

Noise: Meters, Performance of, in terms of the Primary Standard, B. G. Churcher and A. J. King, 331; and the Nation, Dr. G. W. C. Kaye, 408; 446; 490; Dr. A. H. Davis (*Review*), 637

North: -East Coast Institution of Engineers and Shipbuilders, awards made to H. Hunter, H. E. L. Martin and R. A. Lyall, 500; Pole Station, 765; Sea and Baltic, Parasitic Copepods of the, G. M. van Oorde-de Lint and J. H. Schuurmans, 686; -West Passage," New, 802; Polar Station, The Soviet, 1040

Northumbrian Art, Scandinavian Influence on, T. D. Kendrick, 1090

Norway, Medical Literature of [1837], 598

Nova Herculis, Spectrum of, D. B. McLaughlin, 593

Nuclear Particles, Interaction of, Dr. N. Kemmer, 192

Nuffield College, Oxford, 799

Nutrition: and Dietetics (*Review*), 829; and Health, 874; Final Report of the Mixed Committee of the League of Nations on the relation of Nutrition to Health, Agriculture and Economic Policy, 874

Nutritional Science: Social and Political Application of, 305; Social Aspects of, 865

O_2^+ Bands, Visible, Rotational Analysis of the, T. E. Nevin, 1101

OΣ 79, Orbit of, L. T. S. Syms, 688

Oakhurst Shelter, George, Archæology of the, A. J. H. Goodwin, and others, 167; A. J. H. Goodwin (6), 334; (6 and 7), 656

Occipital Perforation in the Anthropoids, Prognathism, Cranial Capacity and Area of the, E. Pittard and H. A. Seylan, 737

Octanes, A. Maman, 656

Œstradiol Monobenzoate, Inhibition by, Response of the Pigeon Crop Gland to Prolactin: Drs. S. J. Folley and P. White, 505

Œstrous Reactions, including Mating, produced by Triphenyl Ethylene, J. M. Robson and Dr. A. Schönberg, 196

Official Statistics of the United Kingdom, Guide to Current, for 1936, 1057

Ohio–Mississippi Floods of 1937, The, R. W. Davenport, 666

O—H Raman Frequency in Inorganic Acids, The, Dr. C. S. Venkateswaran, 151

Oil: Drops, Collision of Two, and the Stability of a Non-spherical Oil-drop, Yoshio Ishida, 70; Well Casing, a New Type of, Threaded Connexion for, W. M. Frame, 117; from Coal, Commercial Production of, Lord McGowan, 143; Drops, Two, Collision of, and the Stability of a Non-spherical Oil Drop, Y. Ishida, 158; Transport *in the* Middle East, Col. H. E. Medlicott, 312; Industry, Education and Training for the, Prof. A. W. Nash, 459; Engine, Two-stroke Cycle, Development of the, W. S. Burn, 597; Industry, Indian, P. Evans, 765; Origin of, Dr. P. D. Trask, 857

Oils from Irish-grown Plants, 843
Oldoway-Expedition 1913, Wissenschaftliche Ergebnisse der, Herausgegeben von Prof. H. Reck. Neue Folge, Heft 4 (*Review*), 6
Omnibus Workers, Digestive Troubles Among, 269
Ophelia cluthensis McGuire, Anatomy of, R. S. Brown, 292
Opium, Indian, Chemistry of, Dr. H. B. Dunnicliff, 92
Optical: Contact, Propagation of, Dr. J. Weir French, 321; Sensitizing of Silver Halides by Dyes, Mechanism of, Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker, 1096
Optics: Experimental (*Review*), 216; Introduction to, Dr. G. B. Deodhar (*Review*), 216
Orcades, The S.S., 498
Organic: Syntheses, L. F. Fieser, editor-in-chief. Vol. 17 (*Review*), 49; Evolution, Processes of, 379; Oxides, Dissociable, C. Dufraisse and J. Houpillart, 1027
Osiris, Marriage of, G. D. Hornblower, 854
Osteopathy ?, What is, Drs. C. Hill and H. A. Clegg (*Review*), 788
Overheads, Control of, 354
Owl, Little, Food of the, 1103
Oxford: Farming Conference, Forthcoming, 928; University: Dr. A. D. Gardner appointed reader in bacteriology; conferment of title of professor on Dr. A. D. Gardner; Dr. A. H. T. Robb-Smith appointed assistant director of pathology at the Nuffield Institute; G. L. Camm awarded the senior mathematical scholarship; Dr. H. M. Sinclair elected an official fellow and tutor in physiology at Magdalen College; J. F. Hope Simpson elected a senior scholar in botany and J. A. Moy-Thomas re-elected a lecturer in zoology; M. Abercrombie elected a junior research fellow at Queen's College and E. P. Abraham to a taberdarship; R. Campbell Thompson elected Shillito reader in Assyriology, 38; E. H. Leach appointed William Hulme lecturer in physiology at Brasenose College; M. S. Wills awarded the Scott scholarship in physics; F. G. W. Knowles elected to the Naples biological scholarship, and F. Fulton awarded the Radcliffe scholarship in pharmacology, 166; Prof. J. H. Burn appointed professor of pharmacology, 227; R. H. Hodgkin elected provost of Queen's College, 676; further gifts from Lord Nuffield, 679; Dr. G. M. B. Dobson elected an official fellow of Merton College and Prof. R. Campbell Thompson a professorial fellow; Dr. S. Flexner and Dr. J. A. Gunn elected supernumerary fellows of Balliol College, Dr. J. H. Burn a professorial fellow and J. St. L. Philpot a senior research fellow; Dr. A. A. Bake appointed a senior research fellow of Brasenose College, 694; Lord Nuffield's new gifts to, 697; Nuffield College, 799; conferment of the degree of M.A. on Lord Nuffield; Dr. L. J. Witts appointed Nuffield professor of clinical medicine; award of the Scott scholarship for research in physics to J. G. Daunt; gift from the Rockefeller Foundation, 819; conferment of an honorary doctorate on Dr. R. R. Marett; K. A. H. Murray elected fellow and bursar of Lincoln College, 862; conferment of an honorary doctorate on Dr. R. R. Marett, 923; Dr. J. V. Harrison elected lecturer and demonstrator in geology; students in receipt of financial assistance, 1026; Early Astronomical Instruments, Dr. R. T. Gunther, 1089
Oxiana, The Road to, R. Byron (*Review*), 788
Oxidation: in the Living Cell, Distinguishing the Zones of, by the Method of Cobalt Salts, P. Joyet-Lavergne, 125; Catalyst, A New, J. G. Dewan and D. E. Green, 1097
Oxide Film Formation on Metals, Polarimetric studies of, A. B. Winterbottom, 364
Oxides: in the Extreme Infra-red, Transmission of some, M. Parodi, 208; formed on Iron, Electron Diffraction Studies of, T. Iimori, 276
Oxonium Compounds, Raman Spectra of, Dr. G. Briegleb and W. Lauppe, 236
Oxyacids, Polarimetric Titration of the, F. Gorski, 167
Oxygen, Consumption of, in Sea Water under Controlled Laboratory Conditions, H. R. Seiwell, 506
Oxy-hydrogen Blow-pipe, Hare and the [1837], 291
Oxyporphyrin Hæmatin Compound, An, as Intermediate between Protohæmatin and Verdohæmatin, Dr. A. Lemberg, B. Cortis-Jones and M. Norrie, 65
Oyster: Sex-Biology of the, and the Salmon, Prof. J. H. Orton, 68; and other Fisheries of Great Britain (*Review*), 952; Biology and Oyster Culture: being the Buckland lectures for 1935, Prof. J. H. Orton (*Review*), 952
Oysters in Tanks, Breeding of, H. A. Cole, 854
Ozone in the Oxidation of Aldehydes, Calatytic action of, E. Briner and E. Perrottet, 737

Pacific Seismological Stations, Reliability of, Dr. H. Jeffreys, 237
Pain Nerves, T. Lewis and E. E. Pochin, 325
Paintings, The Natural Philosophy of, F. I. G. Rawlins, 219
Palæmon, The Indian River Prawn, Dr. S. S. Patwardhan, 580
Palæolithic: Man: in Brittany, R. Mazères, 352; in Norfolk, J. E. Sainty, 731; Succession in England, T. T. Paterson, 775
Palæozoic Strata near Taralga, N.S.W., G. F. K. Naylor, 377
Palao Biological Station, 735
Paleocene: Faunas of the San Juan Basin, New Mexico, late Dr. W. D. Matthew (*Review*), 46; Mammals (*Review*), 46
Palestine: Early, Fauna and Climate of, Prof. L. Picard, 497; foundation of a Hillel prize for medical work in, 722; *Journal of Botany and Horticultural Science*, 1057
Pancreatic Extract, Action of, on Fatty Liver, B. Shapiro and Prof. E. Wertheimer, 771
Papain, Natural Activation of, Prof. M. Frankel and R. Maimin, 1015
Papua, Mount Hagen, Natives of, F. E. Williams, 115
Parachute Descent, A Fatal [1837], 166
Para-Cresol from the Urine of Pregnant Mares, Dr. P. G. Marshall, 362
Paraguay, Fishes of, Prof. N. E. Pearson, 510
Parahydrogen, Liquid, R. B. Scott and F. G. Brickwedde, 1020
Parallelism, A Remarkable, R. Goldschmidt, 83
Paralysis, Potassium and, Aitken, Allott, Castleden and Walker, 367
Paramagnetic Solutions, Two, Thermomagnetic study of, A. Nicolau, 905
Paramecium: Fragments, Movement within, T. Hosoi, 647; *aurelia*: Sex, Sex Inheritance and Sex Determination in, T. M. Sonneborn, 779; Inheritance of Sex at Endomixis in, R. F. Kimball, 943
Parapsychology, Journal of, Prof. W. McDougall, 272
Parasitic Nematodes, Physiology of the (*Review*), 526
Paris: Academy of Sciences, election of Prof. P. Montel as a member of the Section of Geometry, 104; International Exhibition, 1937, The Palace of Discovery at the, Dr. P. Biguard, 328; University, Dr. Roussy elected rector of, 888; Faculty of Medicine, Dr. Crouzon appointed professor of social medicine in the, 929; -Orléans and Midi Railways, Electrification of the, A. Bachellery, 1025
Parliament, Science in [1837], 333
Parliamentary Science Committee, Executive of the, 721
Partridge Stocks and Mortalities, 616
Passerine Birds of Ethiopia and Kenya, 591
Pasture Problems, Dr. Winifred E. Brenchley, 916
Pavlov: and his School: the Theory of Conditioned Reflexes, Prof. Y. P. Frolov. Translated by C. P. Dutt (*Review*), 700; Biological Station in memory of, 803
Peace: the Promotion of, A Petition on, 185; Year Book, 1937, 420
Peaches and Plums, Ripening, Evolution of a Growth-Inhibiting Emanation from, W. E. Isaac, 1027

Pellagra-Preventing Vitamin, Nicotinic Acid and the, Dr. L. Harris, 1070

Penguin-breeding Record at Edinburgh, New, 187

Pennsylvanian Society of New York, award of the medal for distinguished service to Dr. V. G. Heiser, 274

Pentaerythritol : Solid, Hydrogen Bridges in, I. Nitta and T. Watanabé, 365 ; Crystalline Structure of, F. J. Llewellyn, E. G. Cox and T. H. Goodwin, 430

P E P (Political and Economic Planning) : Report on International Trade (*Review*), 133

Periodical Publications in the University Libraries of the British Isles, Union Catalogue of the, excluding titles in the World List of Scientific Periodicals, 1934, Marion G. Roupell (*Review*), 786

Periodicals, A Census of, F. W. Clifford (*Review*), 786

Peroxides, Dissociation of, and the Cold Flame of Hydrocarbons, M. Neumann and P. Toutakin, 598

Persia, Southern, Sir Aural Stein's Expedition in, 885

Personality Survives Death : Messages from Sir William Barrett. Edited by his wife (*Review*), 1078

Personnel Organization, A Psycho-geometrical Representation of, W. R. Dunlop, 152

Persons injured by Accidents, Rehabilitation of, 357

de Perthes, Boucher, and the Foundations of Prehistoric Archæology, L. Aufrère, 261

Petroleum : and Allied Products, Apparatus for Testing, 271 ; Fuels in Canada, 978

Peruvian Textiles, Early, Dr. Lila M. O'Neale, 32

Phanerogams, Living and Fossil, Comparative Ontogeny of, P. Bertrand, 1111

Pharmaceutical Society of Great Britain, Prof. J. H. Gaddum appointed professor of pharmacology and director of the pharmacological laboratories of the, 717

Pharmacy : To-day—its Responsibilities, T. E. Lescher, 228 ; and Physic, Historical Relation of, Sir Humphry Rolleston, 676

Phaseolus vulgaris, Influence of Irradiated Metal Compounds on the growth and development of, O. Ried, 335

Phenological Report for 1936, 230

Philadelphia Academy of Natural Sciences, Report of the, 420

Philippines, Rust Fungi of the, J. C. Arthur and G. B. Cummins, 648

Philosophical Overhaul, O. Lungström, 615

Philosophie scientifique, Congrès International de, Sorbonne, Paris, 1935, Actes du, 8 Fasc. (*Review*), 866

Phlogiston, Levity of Prof. J. R. Partington and Dr. D. McKie, 1089

Phoridæ, Irish Species of the Dipterous Family, H. Schmitz, 1111

Phosphate in Muscle, Coupling of Dismutations with Esterification of, Dr. Dorothy M. Needham and R. K. Pillai, 64

Phosphine and Arsine Derivatives of the Group I (*b*) Metals : Volatile Derivatives of Gold, Drs. F. G. Mann and A. F. Wells, 502

Phosphors, Effect of Pressure on, N. Riehl and H. Ortmann, 593

Phosphorus : and Calcium Deficiency Diseases as two Etiologically Distinct Entities, Dr. P. J. Du Toit and Dr. A. S. Malan, 153 ; Radioactive, Effect of, upon the blood of Growing Chicks, K. G. Scott and S. F. Cook, 293 ; Exchange in Yeast, Prof. G. Hevesy, Dr. K. Linderstrøm-Lang and N. Nielsen, 725 ; Atomic Weight of, Hönigschmid, 856 ; Pentachloride, Stereochemical Structure of, H. Moureu, M. Magat and G. Wetroff, 868

Phosphorylation and Respiration, H. Kalckar, 1103

Photochemie, Allgemeine, Prof. J. Plotnikow. Zweite Auflage (*Review*), 444

Photo-electric Control in Industry, A. L. Whiteley, 927

Photographic : Plates, Sensitized, Position of Masition of Maximum Optical Sensitivity of, S. Natanson, 197 ; Process, Mechanism of the, E. R. Davies ; Dr. S. O. Rawling ; Prof. N. F. Mott ; Dr. W. F. Berg, 997 ; Latent Image, Theory of the Photolysis of Silver Bromide and the, Dr. R. W. Gurney and Prof. N. F. Mott, 1037.

Photography : Stereoscopic, Practical, Dr. J. Moir Dalzell (*Review*), 528 ; Dr. C. E. K. Mees (*Review*), 566

Photoluminescence, réunion Internationale de, Varsovie, 20–25 Mai 1936, Rapports sur la photoluminescence présentés à la, Prof. S. Pieńkowski et Dr. W. Kapuściński ; W. C. Price (*Review*), 787

Photoperiodic After-Effect, Prof. R. H. Stoughton and D. R. Hole, 808

Photosynthesis of Carbohydrates *in vitro*, Prof. E. C. C. Baly, 930

Phycomyces, Growth Factors for, H. M. Sinclair, 361

Physical : Society, award of the Duddell medal to Prof. W. G. Cady, 55 ; Units, Standardization of, L. J. Briggs, 122 ; Fitness, National Factors of, Prof. A. V. Hill (*Review*), 561

Physics : Keeping Pace with, Dr. W. H. George (*Review*), 443 ; Reports and Progress in. Vol. 3, General Editor : Prof. A. Ferguson (*Review*), 443

Physikalischen Eigenschaften und chemischer Konstitution, Zusammenhänge zwischen, Prof. R. Kremann. Mitbearbeitet von Dr. M. Pestemer (*Review*), 831

Physikers, Die mathematischen Hilfsmittel des, Prof. E. Madelung. Unter Mitarbeit von Dr. K. Boehle und Dr. S. Flügge. Dritte Auflage (*Review*), 218

Physiological Patterns and Mental Disturbances, J. W. Thompson, W. Corwin and J. H. Aste-Salazar, 1062

Physiology : in Health and Disease, Prof. C. J. Wiggers. Second edition (*Review*), 133 ; in General Education, 659

'Phytocarcinomata', Colchicine and Plant Hormones, L. Havas, 191

Pig Production, Bacon Development Board. Report No. 7, Selected Abstracts on, 965

Pigmy Cemetery, A [1837], 291

Pilgrim Trust Lecture, Sir William Bragg on the, 961

Pipes : and Smoking in South Africa, P. W. Laidler, 656 ; Bands and Joints, Geometry of Conical, W. Sellar, 900

Pitch Recorder, A Direct-reading, and its applications to Music and Speech, J. Obata and R. Kobayashi, 695

Pituitary : Extracts and Gastric Ulcers, Prof. E. C. Dodds, 159 ; Amphibian, Gonadotropic activity of, H. Zwarenstein, 656 ; Extracts, Anterior, Restropic effects of, C. Wetzler-Ligeti and Dr. B. P. Wiesner, 892

Planet, New Minor, close to the Earth, 928

Plankton : Animals, Biology of, R. S. Wimpenny, 284 ; Collector for Fast Towing, A, E. L. Pierce, 1014

Plant : Diseases of Great Britain : The, a Bibliography, compiled and annotated by Dr. G. C. Ainsworth (*Review*), 91 ; Influence of one, on another which is remote from it, H. Molisch, 125 ; Hormones, Colchicine, 'Phytocarcinomata' and, L. Havas, 191 ; Protection : the Scientific Principles of, with special reference to Chemical Control, Dr. H. Martin (*Review*), 384 ; Hormone Investigations, 720 ; Ecology of Limestone Pavements, Miss A. Bennett, 731 ; Products, Overseas, J. H. Holland (*Review*), 914 ; Life Forms, Prof. C. Raunkiaer. Translated by H. Gilbert-Carter, 1035 ; Materials, Drying of, A. H. Burgess, 1104

Plants : Growth Hormones in, Prof. B. Jensen. Translated and revised by G. S. Avery, jun., and P. R. Burkholder, with the collaboration of Harriet B. Creighton and Beatrice A. Scheer (*Review*), 257 ; Growth in, Mechanism of, Prof. J. H. Priestley (*Review*), 257 ; Arctic and Temperate, Annual Changes in the Osmotic Value of some, H. G. Wager and Elizabeth M. Wager, 376 ; Modern Study of, Education and the, Prof. E. J. Salisbury, 415 ; 669 ; 707 ; Ornamental, Diseases of, D. E. Green ; A. Beaumont and P. H. Gregory, 511 ; in the Western portion of the Little Karroo, Geographical distribution of, M. R. Levyns, 657 ; Drift of Net Assimilation Rate in, R. F. Williams, 1099

Platyedra gossypiella Saunders, Nocturnal Habits of, F. A. Squire, 69

Pleistocene History of the West Midlands, The, Prof. L. J. Wills, 995

Pleuronectidæ, Feeding Habits in, H. Muir Evans, 116
Ploughing by Steam [1837], 81
Pneumonia, Problem of Chemotherapy in, Dr. W. W. G. Maclachlan, 901
Poa, genus, Cytology of the, J. M. Armstrong, 368
Poetry and Astronomy, Prof. F. W. Grover, 146
Poland, Universities of, 231
Polar Year Expedition, British, Fort Rae, N.W. Canada, 1932–33. 2 Vols. (*Review*), 825
Pollen of some Ranunculaceæ, Composition of the, and on their Systematic Position, Mme. C. Sora Bourdouil, 656
Pollution of Sea and Shore by Oil, Prof. N. K. Adam, 100
Polonium: α-Particles: Shortening of the range of, by Oblique Emission from the source, J. Schintlmeister, 821; Short-range Particles emitted when, are scattered by Heavy Nuclei, W. Jentschke and G. Stetter, 821; The γ-Rays of, H. C. Webster, 852
Poly-acids, Constitution of the, Dr. J. S. Anderson, 850
Polygons, Potential of, and Elementary Geometry, G. Bilger, 376
Polymerization, The Kinetics of, Prof. A. C. Cuthbertson, G. Gee and Prof. E. K. Rideal, 889
Polymorphic Transitions of Inorganic Compounds to 50,000 kgm./cm.^{2}, Prof. P. W. Bridgman, 83
Polymorphism under Pressure, Prof. P. W. Bridgman, 899
Polynesia: Central, Religion and Social Organization in, R. W. Williamson. Edited by Dr. R. Piddington (*Review*), 1080; through Many Eyes, A. M. Hocart (*Review*), 1080
Polyploidy, Mechanism of, through Colchicine, B. R. Nebel, 1101
Polypores, Wood-rotting, Enzymes of, Dr. S. R. Bose and S. N. Sarkar, 813
Pomo Culture, E. W. Gifford and Prof. A. L. Kroeber, 686
Pond Life (*Review*), 992
Pontifical Academy of Sciences, First Annual Report, 965
Population: Density, Problems of, Prof. R. Pearl, 32; Changing Distribution of, Prof. C. B. Fawcett, 411; Congress, International, in Paris, 471; Statistics, 1003
Popular Statistics, 1044
Porcellanids and Pinnotherids from Tropical North American Waters, S. A. Glassel, 33
Porous Structure, Investigation of, G. Graue and N. Riehl, 327
Porphyrinuria, Congenital: Living Animal Cases of, P. J. Fourie and Dr. C. Rimington, 68; Porphyrins of the I and III Series in, Dr. C. Rimington, 105
Portolan Charts, The Problem of the (*Review*), 662
Positron and Electron Pairs, Production of, by bombardment of Mercury with β-Particles of Low Energy, Dr. F. C. Champion and A. Barber, 105
Postular Fever and Purpura Fever of the Rocky Mountains, Crossed immunity between the, G. Blane and M. Baltazard, 905
Potassium: Isotopes of, J. H. Yoe and R. T. Hall, 34; Resonance Lines of, Intensity Ratios of the Hyperfine Structure Components of the, Dr. D. A. Jackson and H. Kuhn, 276; and Paralysis, Aitken, Allott, Castleden and Walker, 367
Potato: The, in its Early Home and Its Introduction into Europe, Dr. R. N. Salaman (Masters lectures), 159; Vitamin C in the, J. B. H. Ijdo, 977; Synonym Committee, Report for 1936, 1008; Slopes, Standardization of, for Bacteriological Tests, D. Ward Cutler and Miss Mabel Dunkley, 1015; Flowers and Dissemination of Potato Viruses, Dr. G. Cockerham, 1100
Pottery in the Palæolithic period, J. P. T. Burchell, 800
Prediction: Some Cases of, A Study, Dame Edith Lyttelton (*Review*), 1078
Pregnancy, Nutritional Requirements of, Sir Robert McCarrison; Dame Louise McIlroy, 186
Prehistoric: Archæology, Boucher de Perthes and the Foundations of, L. Aufrère, 261; Finds at Glasgow, 540
Primates from the Miocene of Lower Austria, Two new remains of, K. Ehrenberg, 125
Privilege, Registration and, 660
Probability, Theory of, International Conference on the, Prof. E. L. Dodd and Dr. J. Neyman, 938
Professional Civil Servants, Institution of, Eighteenth annual report for 1936, 580
Progesterone alone and in combination with the other Sexual Hormones, Effects on Ovariectomozed Rats of, Dr. V. Korenchevsky and K. Hall, 154
Prohibition and Cirrhosis of the Liver, Dr. C. C. Weeks, 20
Prolactin: Response of the Pigeon Crop Gland to, inhibition by Œstradiol Monobenzoate, Drs. S. J. Folley and P. White, 505
Proliferation-promoting Substances from Cells injured by Ultra-violet Radiation, G. S. Sperti, Prof. J. R. Loofbourow and Sister Cecilia Marie Dwyer, 643
Prontosil in Puerperal Infections, G. F. Gibberd and others, 284
Prosperity Beckons: Dawn of the Alcohol Era, Dr. W. J. Hale (*Review*), 637; Protein, Structure of, Prof. C. R. Harington and others, 491
Proteins: Patterns of, Dr. Dorothy M. Wrinch, 244; and Metaphosphoric Acid, Reaction between, Dr. H. Hermann and G. Perlmann, 807; 'Fibrous' and 'Globular', Relation between, Dr. W. T. Astbury, 968
Proton tracks, Measurement of the length of, by the Photographic Method, Dr. Marietta Blau and Dr. Hertha Wambacher, 252
Protoplasm, Structure of, Dr. A. R. Moore, 367
Protoplasmic Streaming, Action of Auxin on, Prof. K. V. Thimann and Miss Beatrice M. Sweeney, 807
Protozoa, Effects of Salts on Emergence from the Cyst in, K. V. Thimann and A. J. Haagen-Smit, 645
Prussian Academy of Sciences, Philosophical and Historical Section, Prof. F. W. Thomas elected a corresponding fellow of the, 55
Psittacosis, Laboratory Diagnosis of, 32
Psychology: Medical, Modern Discoveries in, Dr. C. Allen (*Review*), 343; in Autobiography, A History of, Vol. 3, J. R. Angell and others (*Review*), 830; Down the Ages, Prof. C. Spearman. 2 Vols. (*Review*), 909; Science in, Prof. F. Aveling (*Review*), 909
Psychopathology, A Survey of (*Review*), 343
Public Health in Great Britain, Sir Arthur MacNalty, 927
Pultusk: Meteorite, Number of Fragments of the, Dr. E. Stenz, 113; Stones, Meteorites: and the Spelling of "Widmanstätten Figures", Prof. F. A. Paneth, 504; Dr. L. J. Spencer, 589; Prof. F. A. Paneth, 809
Purple, Visual, Absorption Curve for, and the Electrical Response of the Frog's Eye, Prof. R. Granit, 972
Pygmy Hosts, Revisiting My, Dr. P. Schebesta. Translated by G. Griffin (*Review*), 445
Pyrimidine and Thiazole Intermediates as Substitutes for Vitamin B_1, W. J. Robbins, Mary A. Bartley, A. G. Hogan and L. R. Richardson, 779
'Pyrotenax', a Fire-resisting Cable, 887
Pyrroles Derived from Acetonylacetone, S. J. Hazlewood, G. K. Hughes, F. Lions and others, 895
Pyruvic Acid Dehydrogenation, Vitamin B_1, and Cocarboxylase, F. L. Lipmann, 25

Quantiques, theories, Introduction mathématique aux, Prof. G. Julia (*Review*), 950
Quantitative Inheritance, Relation of Gene to Character in, E. W. Sinnott, 83; Analysis: a Theoretical approach, Prof. W. Rieman, III and Dr. J. D. Neuss (*Review*), 914
Quantity Surveying for Builders, W. L. Evershed. Fourth edition (*Review*), 7
Quantum: Statistics, Joule-Thomson Effect and, Dr. D. S. Kothari and B. N. Srivasava, 970; Low, Ionizing Radiations of, Emitted Spontaneously by the Ordinary Metals, G. Reboul and J. Reboul, 1073
Quaternary Deposits in the Traun Valley Region above Gmunden, Geological Analysis of the, G. Götsinger, 41
Quaternions, Functions of, V. C. A. Ferraro, 1111
Queen Mary: and the Bodleian Extension, 15; College Jubilee Celebration, 1903
Quinault Indians, Washington, U.S.A., 201

'Racemic Acid', Use of the name, Prof. A. Findlay, 22
Races et Racisme, 458
Racial: Doctrine and Social Evolution, 945; Evolution and Archæology, Prof. H. J. Fleure (Huxley memorial lecture), 945, 981
Radcliffe Observatory, Pretoria, 841
Radiant Energy, Measurement of. Edited by W. E. Forsythe; Dr. N. R. Campbell (*Review*), 828
Radio: Communication: Fading in, Reduction of, 76; Phase Fading in Long-distance, Control of, Drs. A. L. Green and O. O. Pulley, 76; Exhibition, The, at Olympia, 474; Waves in the Atmosphere, Reflection of, R. A. Watson-Watt, A. F. Wilkins and E. G. Bowen, 512; Research, Foundation by J. W. O. Hamilton of prizes for, 641; Fadings, Bright Solar Eruptions and, in 1935–36, H. W. Newton and H. J. Barton, 688; -phosphorus in Tissues of Growing Chicks, Deposition of, S. F. Cook, K. G. Scott and P. Abelson, 944; -sodium in Normal Human Subjects, Rates of Absorption of, J. G. Hamilton, 944; Communication, Guglielmo Marconi and the Development of, Sir Ambrose Fleming, 963
Radioactive: Substances in the body of Rats, Retention of, and the Lethal Dose, Dr. F. Běhounek and F. V. Novák, 106; Measurements, Utilization of Photoelements with semi-conducting layer for, P. Bonét-Maury, 208; Elements, Artificial, Production of, A. Eckardt, 649
Radiology: British Institute of, Annual Congress and Exhibition, 1069
Radish and Turnip, Crosses between, L. E. Morris and R. H. Richharia, 285
Radium: Therapy, Research on, 313; Committee, Report for 1936, 333; Therapy, Science in, 1108
Rain, Observations on [1837], 819
Rainfall, British, 1936 (*Review*), 873
Rainstorms, Run-off after, J. R. Daymond, 470
Raman Spectra: of Oxonium Compounds, Dr. G. Briegleb and W. Lauppe, 236; of Deuteroethylenes, Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse, 323; of the Two Forms of Phosphorus Pentachloride, H. Moureu, M. Mogat and G. Wétroff, 598; of Acrylic Acid and of Methyl Methacrylate, both monomer and polymerized, D. Monnier, B. Susz and E. Briner, 737
Ramsay Memorial Fellowships, award of, 1008
Random Observations, Tests for, W. O. Kermack and A. G. McKendrick, 369
Rare: Earths, Separation of the, Fischer, Dietz and Jübermann, 74; Earth Sulphates, Magnetic Anisotropy of, and the Asymmetry of their Crystalline Fields, Prof. K. S. Krishnan and A. Mookherji, 549
Rathmullen District, Co. Donegal, Structure of the, W. J. McCallien, 167
Rats: Adrenals of Normal and of Castrated Male, Histological Changes produced by Castration and by Sex Hormones in the, K. Hall and Dr. V. Korenchevsky, 318; Liver Extract and Hæmoglobin in, A. L. Bacharach and H. E. Glynn, 896
Raw Materials, Distribution of, Prof. I. Högbom, 801
Reaction: Heat of, The Sign and Symbol of, Dr. H. J. S. Sand, 809; Kinetics, Discussion on, 902
Reading University: Dr. G. W. Scott Blair appointed head if the Dairy Chemistry Department of the National Institute for Research in Dairying, 654; Sir Samuel Hoare elected chancellor, 694
Reality in Physics, Problem of, Prof. R. Ortvay, 313
Rebels: Faithful, a Study in Jewish Speculative Thought, Dr. I. Levine (*Review*), 218
Recollections of My Life, Santiago Ramón y Cajal, translated by Prof. E. H. Craigie, with the assistance of Prof. J. Cano (*Review*), 617
Red: Compounds formed by Picric Acid and Creatinine in the Presence of Sodium Hydroxide, A. Bolliger, 519; Rocks, Origin of the, Dr. R. L. Sherlock and others, 554
Refraction Effect, a Double, in Certain Fatty Materials, L. Bellingham, 70
Registration: and Privilege, 660; and Population Trends, Dr. R. R. Kuczynski, 966
Relativity: Double Stars and, Prof. T. Levi-Civita, 470; The Philosophy of, Prof. A. P. Ushenko (*Review*), 636; Theory of Protons and Electrons, Sir Arthur Eddington (*Review*), 742
Renaissance française, award of the Paul Appel prize and gold medal of the, to the French League against Cancer, 104
Rengma Nagas, The, J. P. Mills (*Review*), 564
Rensselaer Polytechnic Institute, Work of the, 419
Repton School Science Society, 18
Research and Industry, 437
Reservoir Dams, Fault-movements and the Safety of, G. D. Louderback, 160
Resins, Synthetic, Examination of, by X-Rays, N. J. L. Megson and W. A. Wood, 642
Resorcinol, A New Form of, A. R. Ubbelohde and Dr. J. M. Robertson, 239
Respiration, Artificial, Production of, by Rhythmic Stimulation of the Phrenic Nerves, Prof. R. A. Waud, 849
Retina, Structure of the, and the Role of its Visual Purple, Dr. R. J. Lythgoe (Thomas Young oration), 1045
Rhodes-Livingstone Memorial, Proposed, 57
Rhodesia, Antiquity of Man in, A. L. Armstrong, Rev. N. Jones and H. B. Maufe, 469
Rhododendron: A Pest of the, G. F. Wilson, 202; Hybrids of the, F. C. Puddle, 813
Rice, Genetics of, B. S. Kadam and others, 1068
Rickets: Experimental, Influence of Iodine and of Some Inorganic and Organic Iodine Compounds on the Bone Lesions of, R. Lecoq, 334; Experimental, of Rats, Protective Effect against of a Single Massive Dose of Vitamin D, Dr. H. Rotter, 973
Riga, Institution of an Institute for Anatomy, Physiology and Hygiene at, 21
Rigi Railway, Electrification of the, 355
Ritchie, F. R. S., Prof. William, [1837], 476
River Flow Around Bends, Dr. B. Cunningham, 728; Records, Capt. W. N. McClean. Series A: River Garry. Sheet No. 1; Sheet B: River Moriston. Sheet No. 1, Series C: River Ness. Sheets 1–14 (*Review*), 872
Rivers, R. K. Gresswell, 496
Riveted Joints in Boilers, Chemical Intercrystalline Fracture of, Dr. S. F. Dorey, 597
Road: Engineering, Principles of, Prof. H. J. Collins and C. A. Hart (*Review*), 441; Rules of the, Enforcement of the, Dr. H. C. Dickinson, 580; Design and Road Safety, F. C. Cook, 650; Research: Board, Report of the, for year ended 31st March, 1936, 983; Progress in, 983
Roads, Coloured, C. W. Manlove, 1091
Roaring Sands of the Kalahari Desert, A. D. Lewis, 285
Rock Magmas and their Products, Prof. C. E. Tilley (*Review*), 913
Rockefeller: Travelling Fellowships in Medicine, award of, 61; Institute for Medical Research, Hospital of the, retirement of Dr. R. Cole and appointment of Dr. T. M. Rivers as director, 104; Foundation, Activities of the, in 1936, R. Fosdick, 500
Rocks and Minerals, Chemical Analysis of, R. C. Wells, 202
Roman: Site at Wroxeter, Excavations on the, 352; Britain: Local Government in, 394; Recent Excavations in, 654; Pottery from Ewell, Surrey, 924
Röntgenstrahlen, Materialprüfung mit, Prof. R. Glocker. Zweite auflage (*Review*), 914
Ropes, Winding, Fibre Cores in, 818
Ross Institute, Activities of the, 581
Royal: Aero Club, Miss Jean Batten awarded the gold medal of the, 844; Aeronautical Society, award of medals and prizes, 1094; Agricultural Society, ninety-seventh volume, 357; Asiatic Society, award of universities essay prizes to D. P. Costello and J. Bowman, 967; Cancer Hospital, gift to the, by A. Chester Beatty, 844; College of Physicians of London, award of the Baly medal to Prof. E. L. Kennaway, 232;

presentation of the Baly medal to Prof. E. L. Kennaway, 722; College of Surgeons of England, opening of the Bernhard Baron laboratories, 1045; Cornwall Polytechnic Society, Annual Report, 59; Geographical Society, [1837], 1026; Institute: of British Architecture, Sir William Bragg elected an honorary associate of the, 21; of International Affairs, Prof. A. G. B. Fisher appointed professor of international economics, 842; Meteorological Society, award of the Howard prize to Cadet Ralph Wills, 21; award of the Symons gold medal to Dr. G. M. B. Dobson, 929; Prof. A. S. Spilhaus elected a foreign member of the, 1058; Navy, The Engineering Branch of the, [1836], 128; Observatory, Greenwich, Dr. R. d'E. Atkinson appointed chief assistant in the, 457; Society: J. D. G. Davies appointed assistant secretary, 460; award of Royal medals to Prof. N. V. Sidgwick and Prof. A. H. R. Buller, Copley medal to Sir Henry Dale, Davy medal to Prof. H. Fischer, Buchanan medal to Gen. F. F. Russell, Sylvester medal to Prof. A. E. H. Love and Hughes medal to Prof. E. O. Lawrence; Sir William Bragg recommended for re-election as president. 840; new barometer [1837], 862; Anniversary of the, [1837], 941; Anniversary meeting and presentation of medals, 979; Society of Arts, Annual Report, 1008; of Canada, annual meeting; award of the Flavelle medal to Dr. F. D. Adams, the Lorne Pierce medal to Prof. S. Leacock and the Tyrrell medal to A. Fauteux; Prof. A. G. Huntsman elected president for 1937–38, 287; of Edinburgh: election as honorary fellows of Dr. W. T. Calman, J. L. Baird, Prof. C. U. A. Kappers, Prof. M. T. Bogert and Prof. Max Planck, 61; election of officers, 766; of Tropical Medicine and Hygiene, award of the Chalmers medal to Prof. R. M. Gordon, 98; Veterinary College and Hospital, opening of new buildings of the, 884
Rubber, Diffusion Process in, Nature of the, R. M. Barrer, 106
Rubidium-Cæsium Alloys, Diagram of Solidification and Electrical Conductivity of the, E. Rinck, 518
Rural Hygiene, Far Eastern Conference on, 353
Russia: Medical Practitioners in, [1837], 39; Medical Schools in, [1837], 81; Hospitals in, [1837], 207
Rutherford, Lord, Prof. A. S. Eve, 746; Prof. J. Chadwick, 749; Sir J. J. Thomson, 751; Sir William Bragg, 752; Prof. Niels Bohr, 752; Prof. F. Soddy, 753; Prof. E. N. da C. Andrade, 753; Sir Frank Smith, 754; funeral of, 754; further tributes to the late, Prof. S. Meyer, 1047; Prof. A. Norman Shaw; Prof. Niels Bohr, 1048; Prof. G. Hevesy, 1049; Duc de Broglie, 1050; Prof. J. Stark; Prof. O. Hahn, 1051; Prof. E. Fermi, Prof. L. Wertenstein, 1052; Dr. P. Kapitza, 1053
Rye, Spring, Devernalization of, by Anaerobic Conditions and Revernalization by Low Temperature, Prof. F. G. Gregory and O. N. Purvis, 547

Se_2 Molecule, The Ground State of the, Prof. S. S. Bhatnagar, Dr. H. Lessheim and Mohan Lal Khanna, 152
Saccharimeter, New Form of, 678
Sahara, The Threat of the, Prof. E. P. Stebbing, 460
Sailing Yachts, Shapes of, A Law of Hydrostatics and its Influence on the, Eng. Rear-Admiral A. Turner, 597
St. Andrews University: J. Dewar appointed lecturer in chemistry in the United College, T. G. Cowling lecturer in mathematics, and R. E. Stedman, lecturer in philosophy in University College, Dundee, 38; honorary doctorates to be conferred on Prof. G. F. Stout and Dr. W. T. Calman, 80; J. M. Brown appointed lecturer in political science in the United College, and B. S. Robertson lecturer in regional anatomy in Dundee University College, 207; conferment of honorary doctorates on R. F. J. Fairlie, Sir John Simon, Prof. G. F. Stout and Sir Leonard Woolley, 654; conferment of an honorary doctorate on Dr. W. T. Calman, 694
Salcombe Hill, Preservation of, 679
Salicylic Aldehyde Reaction of Csonka-Straub, Specificity of the, Prof. A. E. Braunstein, 427
Salmon: Sex-Biology of the Oyster and the, Prof. J. H. Orton, 68; Migrations of, W. J. M. Menzies, 326; Prof. H. B. Ward, 355
Salters' Institute for Industrial Chemistry, awards made to A. M. Baxt, R. H. Freak, J. L. Tuck and D. H. Wade, 274; Sir Robert Robertson appointed director of the, 722
Samarium, Micro-estimation of, M. Servigne and E. Vassy, 124
Sanriku Earthquake, Seawaves of, 1936, N. Miyabe, 1020
Saps, Vacuolar and Cytoplasmic, Concentration of Solutes in, Dr. E. Phillis and Dr. T. G. Mason, 370
Sarawak, Intoxicants in, E. Banks, 936
Sardine, California, and its Fishery, Frances N. Clark, 858
Sarothamnus scoparius, Constitution of Scoparoside (Scoparine) of, M. Mascré and R. Paris, 125
Savage Hits Back: The, or the White Man through Native Eyes, Prof. J. E. Lips. Translated by V. Benson (*Review*), 619
Scale Insects of North America, Atlas of the, Prof. G. F. Ferris (*Review*), 632
Schmidt, Johannes, medal, award of the, to H. G. Maurice, 104
Schönbein and Faraday, [1837], 39; 777
Science: and Learning, Freedom of, 169; in Social Services, 253; Museum, Annual Report for 1936, 353; and the Life of the Community, Committee on, 358; History of, Cultural Basis of the (*Review*), 439; in Everyday Life, Dr. J. E. R. Constable, 457; and Society, D. Sarnoff, 459; of Life Series, H. G. Wells, Dr. J. Huxley and G. P. Wells. 9 Vols. (*Review*), 484; Agriculture and Industry, Interrelation between, Sir Harry Lindsay, 652; and the Community, J. Ramsay MacDonald (Radford Mather lecture), 756; Invention and Society, W. Kaempffert, 893; and Free Will (*Review*), 871; and Common Sense: an Aristotelian Excursion, Dr. W. R. Thompson (*Review*), 872; in Psychology, Prof. F. Aveling (*Review*), 909; News a Century Ago, 39; 80; 123; 166; 207; 250; 291; 333; 375; 434; 476; 517; 556; 597; 655; 693; 736; 777; 819; 862; 904; 941; 984; 1026; 1072; 1110; and Music, Sir James Jeans (*Review*), 947; and the Unobservable, Prof. H. Dingle, 963; Social Contacts of, Committee on, election of officers, 968; in History, The Spirit of, Prof. C. Singer, 1021; and Technology, History of, Fourth International Congress, 1021; Prof. A. Raymond elected president, 1022; and Social Service, Sir Richard Gregory, Bt., 1088; History of, 1089; in Radium Therapy, 1108; an Institution for the Advancement of, [1837], 1110
Scientific: and Industrial Research, Advisory Council to the Committee of the Privy Council for, Dr. G. M. B. Dobson, Lt.-Col. J. H. M. Greenly and S. K. Thornley appointed members of the, 680; Lord Riverdale appointed chairman and Sir William Bragg a member of the, 888; and Technical Books: British, Select List of Standard, 357; Recent, July 31, v; August 28, v; September 25, v; October 30, v; November 27, v; December 25, iii; Endeavour and Inferiority Complex (*Review*), 617; Training, Necessities of, Lord Leverhulme, 144
Scotland, Astronomer Royal for, retirement of Prof. R. A. Sampson, 227; 47th Annual Report, 229
(*Scylliorhinus canicula*), Changes of Colour by Injection of Pituitary Extracts in a Dogfish, D. R. Barry, 769
Scyphostegia borneensis, Male Inflorescence of, C. Baehni, 737
Sea-Fish Supply, The Nation's: being the Buckland Lectures for 1936, E. Ford (*Review*), 952
Seasons, Nomenclature of the, Dr. J. R. Baker, 890
Sedimentation, Ultracentrifugal, Analytical Measurements of, A. Tiselius, K. O. Pedersen and Prof. The Svedberg, 848
Seismology, Bibliography of, Edited by E. A. Hodgson, 616
Selection and Mental Factors, Dr. G. H. Thomson, 934

Sempervivum, A New Species of, Dr. W. B. Turrill, 1057
Serbian: Gypsy Feast-days, Dr. A. Petrovič, 115; Royal Academy of Sciences, fiftieth anniversary, 422
Severn, River, Hydrography of the, Prof. S. M. Dixon, G. Fitzgibbon and Dr. M. A. Hogan, 73
Sex: Chromosomes, Human, Dr. P. C. Koller, 429; Ratio, The, Prof. F. A. E. Crew, 449; Prof. F. A. E. Crew and others, 958; Behaviour, Effect upon, of a Diet Deficient in Vitamin E, Dr. B. P. Wiesner and A. L. Bacharach, 972
Sexual Periodicity, Dr. F. H. A. Marshall, 284
Sheep: Diseases, Cobalt, and, J. B. E. Patterson, 363; Cobalt Chloride Treatment of, J. K. Dixon, 898
Sheffield University, J. W. Watson appointed assistant lecturer in geography, G. Forbes lecturer in forensic medicine, J. M. Kennedy lecturer in infectious diseases and G. A. de Belin assistant lecturer and research assistant in the department of metallurgy, 207; gift by the City Council for the Extension Fund; E. T. Goodwin and T. D. H. Baber appointed assistant lecturers in mathematics and Dr. Helen Mellanby part-time demonstrator for medical and dental students; resignation of J. W. Frame, J. Jenkins and Dr. E. S. Duthie, 735; twenty-first anniversary of the Society of Glass Technology; new buildings for the department of glass technology, 884; H. J. Barrie appointed demonstrator in pathology and R. B. M. Jenkins assistant lecturer in civil engineering, 904
"Shiva's Temple", Arizona, Investigation of, 537; Dr. H. Anthony, 613
Shoreham Harbour, Excessive Marine Growth in, 966
Short: Waves in Physics, Biology and Medicine, International Congress for, Vienna, Dr. J. B. Bateman, 372
Short-Mayo Composite Aircraft, 539
Show Cases, Illuminated, 812
Showers, Production of, by Heavy Particles, Dr. L. Landau and G. Rumer, 682
Silica Dusts, Solubility of, Dr. E. J. King, 320
Silicon in Steels, Determination of, G. Charpy, 820
Silkworms, Diet of, [1837], 207
Silver: Nitride, Slow Thermal Dissociation of, Ultra-Violet Emission Spectrum of the, R. Audubert, 518; Halides, Optical Sensitizing of, by Dyes, Mechanism of, Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker, 1096
Sinanthropus: *pekinensis*, Reconstruction of the Entire Skull of an Adult Female Individual of, Prof. F. Weidenreich, 1010; VI, Prof. F. Weidenreich, 1067
Sirius, The Iron Ship, [1837], 556
Siwa, Oasis of, Egyptian Libya, Zoological Expedition to the, J. Omer-Cooper, 919
Skatole as a Root-forming Substance, L. G. G. Warne and A. A. Jackson, 26
Sladen, Percy, Expedition to Lake Titicaca, H. C. Gilson, 877
Sleep and Narcosis, Promotion of, by Dyes, H. Konzett, 821
Smith, Theobald, award in medical science, Dr. R. D. Evans presented with the, 460
Smithsonian Institution, Field Work of the, in 1936, 356; List of the Publications of the, Helen Monro, 616
Smoke Abatement Society: National, Annual Conference at Leeds, Dr. A. L. Roberts, 691
Snake Venoms, The European (*Review*), 744
Snow: Crystals, Prof. U. Nakaya and others, 345; Falling, Physical Investigations on, G. Seligman, 345; Crystal or Snowflake, Sir George Simpson, 729; G. Seligman, 730
Snowflake, Snow Crystal or, Sir George Simpson, 729; G. Seligman, 730
Social: and Economic Problems, International Co-operation in, 1; Services, Science in, 253; Theory and Discipline, R. Brightman (*Review*), 481; Research Organization of, 521; Evolution, Racial Doctrine and, 945; Contacts of Science, Committee on, election of officers, 983; Problem Group ? A, Edited by Dr. C. P. Blacker (*Review*), 993; Sciences Lag, Why, Dr. J. Mayer, 1021; Service, Science and, Sir Richard Gregory, Bt., 1068
Sociology: The Development of, Prof. F. N. House (*Review*), 481; Medical and Psychological Aspects of (*Review*), 993
Soft X-Ray Region, Absorption Edges in the, H. W. B. Skinner and J. E. Johnston, 732
Soil: Erosion and its Control, Prof. Q. C. Ayres (*Review*), 445; Engineering Properties of, C. A. Hogentogler and others (*Review*), 635; Erosion: The Growth of the Desert in Africa and Elsewhere, Sir Daniel Hall, 886
Solar: Eclipse: of June 19, 1936, The, Prof. F. J. M. Stratton and others, 11; Longest, Observations of the, Prof. J. Q. Stewart and T. Stokley, 143; of June 8, 1937, Observations of the, Prof. I. Yamamoto, 501; Corona, Polarization of the, K. G. Zakharin, 586; Eruptions, Bright, and Radio Fadings in 1935–36, H. W. Newton and H. J. Barton, 688; Eclipse, Total, of June 19, 1936, Coronal Emission Lines Observed at the, Prof. R. Sekiguti, 724; Prof. F. J. M. Stratton, 725; Radiation, Absorption of, by the Atmosphere in Band *A*, P. Lejay, 943
Solenoid, Self-inductance of a, Coefficient of, R. Esnault-Pelterie, 1073
Solids, The Grain-like Structure of, Sir William Bragg, 954
Solubility of a Pure Substance, Equation of, Forming a Solid Compound with the Solvent, J. Perreu, 477
Solutes in Vacuolar and Cytoplasmic Saps, Concentration of, Dr. E. Phillis and Dr. T. G. Mason, 370
Solvent Dewaxing, M. Ba Thi, T. G. Hunter, Prof. A. W. Nash and others, 1105
'Sonti' Fermentation, K. Rami Reddi and Dr. V. Subrahmanyan, 33
Sooty Mould Fungi, Ecology of, Miss Lilian Fraser, 1104
Sorbonne, Paris, retirement of Prof. C. Fabry, 883
Soufrière of Saint-Vincent, Reality of an Eruption of the, in, 1718, A. Lacroix, 656
Sound: Intensity, Absolute Measurements of, Prof. E. N. da C. Andrade and R. C. Parker, 34; Music and, Ll. S. Lloyd (*Review*), 947; -Films as Diffraction Gratings for Visual Fourier Analysis of Sound-waves, Dr. D. Brown, 1099
South: Africa: Native Lands in, A "New Deal", 458; Moisture and Farming in, W. R. Thompson (*Review*), 698; African: Protectorates, Gen. Hertzog and Malcolm MacDonald on the, 99; The Future of the, 127; Fishes of the Families Sparidæ and Denticidæ, J. L. B. Smith, 334; Native Cattle, H. H. Curzon and R. W. Thornton, 551; Australia: Mining and Geology in, 312; Natural History and Science in, Dr. C. T. Madigan, 419; -West Essex Technical College, Dr. H. Lowery appointed principal of the, 803; African Larval Trematodes with Forked Tails, F. G. Cawston, 1026
Soviet: Russia, Birth-rate of, 148; North Polar Station, Work at the, 244; Universities, Staff and Student Stipends in, 1007; North Polar Station, The, 1040
Spark Discharge, Development of the, Dr. T. E. Allibone and J. M. Meek, 804
Sparrow, Song, Population Study of the, Margaret M. Nice, 159
Special Libraries and Information Bureaux, Association of, fourteenth annual conference, 652
Spectrometers, Two, for X-Ray Analysis, W. F. de Jong, 768
'Spheroidal': A Mutant in *Drosophila funchis* Affecting Egg Size and Shape, and Fecundity, Prof. F. A. E. Crew and C. Auerbach, 124
Sphinx, The, 314
Spiders, South African Harvest, Odoriferous Glands of, R. F. Lawrence, 209
Spiritualism, Academic (*Review*), 1078
Sporobolus, R. Br., South African Species of, A. P. Goossens, 905
Sport, Mechanics of, Sir Gilbert Walker, 567
Spray Deposits, Protective, Fajans and Martin, 511
Standardization, A Survey of the Present Organization of, National and International, 19

Stane Street, With a Spade on, S. E. Winbolt (*Review*), 486
Star-Begotten: a Biological Fantasia, H. G. Wells, 171
Starch, Cellulose, Glycogen and, Prof. H. Staudinger, 1071
Stars: Variable, of the Cepheid Type, Pulsation of, G. Tiercy and P. Javet, 125; Rotating, Prof. J. A. Carroll, 162; Binary, Masses and Parallaxes of, Dr. C. Barnes, 286; Double, and Relativity, Prof. T. Levi-Cevita, 470
State Intervention and Agriculture, 601
Statistical Mechanics: the Theory of the Properties of Matter in Equilibrium, Prof. R. H. Fowler. Second edition (*Review*), 382
Steam Frigate, The First, [1837], 375
Steels, Very Pure, Some Physical and Chemical Properties of, W. Broniewski, S. Przedpelski and S. Sulowski, 334
Stellar: Colour Indexes, Definition of, P. Rossier, 125; Rotation, A Method of Determining, 162; Spectra, Classification of, W. W. Morgan, 430
"Sterilamp", The, 844
Sterol Group, A Diene Synthesis Applicable to the, A. B. Meggy and Prof. R. Robinson, 282
Sterols and the Bile Acids, Stereochemistry of the, D. A. Peak, 280
Stomatopoda of the Bingham Oceanographic Collection, G. R. Lunz, 551
Stone Age, New, Problems of the, H. J. E. Peake, 551
Stonefly, Graded Mutations in Wings of a, Prof. A. Willey, 112
Storage Reservoirs, G. B. Williams (*Review*), 635
Storstrøm Bridge, The, 577
Strangeways Research Laboratory, Report for 1936, 1092
Stratosphere: Balloon Experiment, Belgian, M. Cosyns, 54; Flight in the, Capt. J. L. Pritchard, 165
Stresses in Engineering Materials, Tests for, D. W. Ginns, 858
Strontium, Isotopes of, 475
Styrene, Catalysed Polymerization of, Kinetics of, Dr. G. Williams, 363
Subject Index to Periodicals, 1936 (*Review*), 665
Subjective Tones, Cancellation, Reinforcement and Measurement of, D. Lewis and M. J. Larsen, 779
Submarine: Daylight, Measurement of, Dr. H. H. Poole, 50; Canyons, Formation of, P. H. Kuenen, 117
Substrate, Use of the Word, Dr. N. K. Adam, 158
Subterranean Forest, [1837], 736
Sudan, Southern, Native Science in, Prof. F. C. Bartlett (*Review*), 338
Sugar in the Body, Distribution of, and the Action of Insulin, L. Pollak and G. Flaum-Fehér, 821
Sulphur as a Factor in the Corrosion of Iron and Steel Structures in the Sea, W. J. Copenhagen (2), 1028
Sun, Continuous Observation of the, International Co-operation for the, and its First Results, L. d'Azambuja, 208; Apparent Enlargement of the, at the Time of Rising and Setting, Dr. Vaughan Cornish, 1082
Sun's Outer Envelope, 310
Sunshine Records, Effect of, Obstacles on, E. G. Bilham, 648
Sunspot: Activity, Recent, 327; Large, Return of a, 358; Photography with a Small Visual Refractor, C. Maby, 552; An Active, 616
Sunspots, A Naked-eye Group of, 190
Super-Nova in *Canes Venatici*, Discovery of a, 500
Superphysical: The, a Review of the Evidence for Continued Existence, Reincarnation, and Mystical States of Consciousness, A. W. Osborn (*Review*), 1078
Supraconductivity: Dr. F. B. Silsbee, 420; A New Conception of, F. London, 793; 834
Surface Action in Biology, Prof. E. K. Rideal, 671
Suspensions, Frictionless Torque-free, Dr. F. T. Holmes, 1105
Suva, Fiji, The Central (Native) Medical School, Sir James Barrett, 472
Swansea Technical College, Dr. F. Heathcoat appointed vice-principal and head of the chemistry department of, 1058
Sweden, A New Hydro-Electric Power Scheme in, 817
Swedish Turnip, Yellow-fleshed, A Non-bulbing Derivative of, M. J. Gorman, 333
Swiss; Society of Natural Sciences, Work of the, 58; Earthquake Service, 189
Sydney University, Dr. E. Ashby appointed professor of botany, 883
Synthesen (Organische), (Organic Syntheses), Dr. R. Asmus (*Review*), 486
Systematics in Relation to General Biology, Association for the Study of, 163
Systèmes de référence et mouvements (physique classique), Prof. A. Sesmat. Parts 5, 6, 7 (*Review*), 994

Tanaina, Ethnography of the, Dr. C. Osgood, 898
Tanning Liquors, Effect of Moulds upon, L. Baens and F. M. Yenko, 687
Taxes and Kineses, Classification of, Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou, 1064
Taxonomy, Genetics and, Dr. W. B. Turrill and others, 572
Taylor's Scientific Memoirs [1837], 862
Tea, A New Purine in, T. B. Johnson, 814
Technical: Institutions, Association of, summer meeting at Blackpool, 79; Processes, Development of New, Dr. H. C. Urey, 901
Technischen Zeitalters: Die Tragik des, Mensch und Maschine im 19 Jahrhundert, O. Veit (*Review*), 45
Technological History (*Review*), 301
Telegraphic: Communication on Railways [1837], 166; Transmitter, Long Wave, Service Area of a, A. L. Green, 900
Teleostomes, Cheek Bones of, T. S. Westoll, 72
Telephone, Extra Receiver for the, 230
Telephony, International, Practical Difficulties in, A. Lignell, 312
Television: Projection, Dr. V. K. Zworykin, W. H. Painter and Dr. R. R. Law, 286; Cable, The, A. Rosen, 355; Equipment, Improvements in, 962; Cyclopaedia, A. T. Witts (*Review*), 1032; on a Large Screen, 1046
Televisor, Telegraphy, Telephone, 188
Tell Duweir, Archæological Excavations at, 1936–37, 99
Tellurium, Molybdenum and Tungsten, Hexaco-ordination of, J. Gupta, 685
Temperature, Secular Trends of, Miss L. F. Lewis, 899
Tenthredinidæ, Thelytokously Parthogenetic, Maturation in the, Prof. A. D. Peacock and Dr. Ann R. Sanderson, 240
Termites, Communal Life Among, H. Donnisthorpe (*Review*), 622
Ternary: Gas Mixtures, Analysis of, by Thermal Conductivity Measurements, J. L. Bolland and Dr. H. W. Melville, 63; Alloys, Investigation of Equilibrium Diagrams of, by X-Rays, A. J. Bradley, H. J. Goldschmidt, H. Lipson and A. Taylor, 543
Terrestrial Life: Foundations of, The Soil and the Green Plant, Sir Frederick Keeble, 1107
Terror, H.M.S., Capt. Back's Voyage in [1837], 862
Testosterone, The effect of Enol-Esters of, Dr. K. Miescher, W. H. Fischer and E. Tschopp, 726
Tetradeuteroethylene, Infra-red Spectrum of, Dr. G. B. B. M. Sutherland and G. K. T. Conn, 644
Tetramethylammonium, Pharmacology of, A. J. Clark and J. Raventos, 325
Tetramethyldiketopiperazine, Diketopiperazine and, Infra-red Spectrum and Molecular Structure of, Dr. L. Kellner, 193
Téviec: station-nécropole mésolithique du Morbihan, Marthe et Saint-Just Péquart, M. Boule et H. Vallois, 329
Textile Institute, award of the medal of the, to Dr. F. W. Eurich, 675
Thallium Hydride, Band Spectrum of, Dr. B. Grundström, 365
Theism: Restated (*Review*), 485; The Philosophical Bases of, Prof. G. Dawes Hicks (Hibbert lectures), (*Review*), 485
Thermionic Valve Data, 1046
Thermodynamic Scale below 1° K., W. Jacyna, 863

Thermodynamical Quantities, Symbols for, 802
Thermo-electric Light [1837], 597
Thiazole and the Growth of Excised Tomato Roots, W. J. Robbins and Mary A. Bartley, 779
Thomas-Gilchrist Basic Process, F. W. Harbord, 1057
Thorium : α-Particles from, Redetermination of the range of, J. Schintlmeister, 519 ; Disintegration of, Detection of α-Particles in the, A. Braun, Dr. P. Preiswerk and P. Scherrer, 682 ; to Uranium in Rocks and in the Sea, Abundance Ratio of, H. Pettersson, 821
Thorpe's Dictionary of Applied Chemistry, Prof. J. F. Thorpe and Dr. M. A. Whiteley. Fourth edition. Vol. 1 (*Review*), 1076
Thunderclouds, Electricity in, Distribution of, Sir George Simpson and F. J. Scrase, 732
Timbers, Gurjun, Apitong, Keruing, Kapur and allied, S. H. Clarke, 326
Time : Measurement, Part 2, 499 ; -Space Continuum," "The, Designation of, Dr. M. O'Gorman, 773
Tissues, Living, The Metabolism of, Dr. E. Holmes (*Review*), 91
Titanium Dioxide, Commercial, Darkening of some, in Daylight, W. O. Williamson, 238
Titicaca, Lake, The Percy Sladen Expedition to, H. C. Gilson, 877
Tobacco : Virus, Mutation in, Dr. H. H. McKinney, 33 ; Mosaic Virus Nucleoprotein, Artificially prepared Visible Paracrystalline Fibres of, R. J. Best, 547 ; Habit, Dr. J. D. Rolleston, 615 ; Mosaic Protein, Dr. W. M. Stanley, 648
Tomato 'Spotted Wilt' Virus, Ecology of, Dr. J. G. Bald, 1019
Torpedo Craft, Evolution of, Sir J. E. Thornycroft, 763
Torus Mandibularis, The, and its ultimate Phylogenic Signification, A. Perier, 737
Trades Union Congress and Science, E. Bevin, 457
Transformation, A New Mode of, A. Debierne, 518
Transplanting, Economic Value of an Experiment in, 101
Transport in France, F. J. Wymer, 1056
Travellers, Instructions for [1837], 819
Tree : remains in and under Peat, Some Climatic Theories in connexion with, A. C. Forbes, 81 ; Growth, Climatic Cycles and, W. S. Glock, 855
Treub Foundation of Buitenzorg, Java, first report, 230
Tri-brom Ethanol, Absorption of, through the Skin, Dr. D. I. Macht, 849
Trigonometry : a Text Book of, for Colleges and Engineering Schools, W. H. H. Cowles and J. E. Thompson (*Review*), 344
Trihornometry : a New Chapter of Conformal Geometry, E. Kasner, 519
Tring Museum, 842
Triphenyl Ethylene, Œstrous Reactions, including Mating, produced by, J. M. Robson and Dr. A. Schönberg, 196
Triterium ?, Tritium or, Dr. K. C. Bailey, 590
Tritium or Triterium ?, Dr. K. C. Bailey, 590
Triton taeniatus, Neural Induction of Plant Tissues in the Ectoderm of, M. N. Ragozina, 199
Tuberculous, Care and After-care of the, Sir Kingsley Wood, 101
Tuberculosis : (Attested Herds) Scheme, 102 ; Origin of, and nature of the Tubercle Bacillus, Prof. J. Tissot, 775
Tumour Cells, Ærobic Glycolysis of, Specific action of Ferricyanide on, Dr. B. Mendel and Miss F. Strelitz, 771
Tungsten : Anodic Polarization of, J. P. E. Duclaux, 208 ; Tellurium, Molybdenum and, Hexaco-ordination of, J. Gupta, 685 ; Clean and of Thoriated, Temperature Variation of the Work Functions of, Dr. A. L. Reimann, 1073
Turbid Solutions in an Electric Field, Optical Rotatory power of, Prof. J. Kunz and R. G. La Baw ; Dr. E. B. Ludlam, A. W. Pryde and H. G. Rule, 194
Twenty-one Years : a Professor Looks out on the Glass Industry, Prof. W. E. S. Turner, 1071
Tyneside Geographical Society, Jubilee of the, 842
Typhoid : Fever, The Bournemouth outbreak of, late Dr. V. Shaw, 145 ; and Typhus Fevers [1837], 250

Ultra-sonic Grating in Liquids, Circular, Miss J. Ĉeřovská, 425
United States : Meteorology in the [1837], 123 ; Examinations in, 189 ; Zoological Expedition to Far East, 356 ; Regional Planning in, 579 ; Soil Erosion in the, Mrs. E. Huxley, 687 ; Adult Education in the, Dr. J. W. Studebaker, 816
Units, Physical, Standardization of, L. J. Briggs, 122
Unst, Shetland Island, Metamorphic Rocks of, Prof. H. H. Read, 731
Upper Air, Investigation of the, Prof. D. Brunt and others, 876
Uranium Dioxide Starting Resistances, 900
Uranyl Phosphites, A. Chrétien and J. Kraft, 251
Universities and Education, Prof. F. G. Baily and others, 689
University : in Modern Life, The, 987 ; The, and the National Life, Dr. R. E. Priestley, 1007 ; Graduates, Employment of, 1022
U.S.S.R. : Fauna of the, 19 ; Genetics and Plant Breeding in the, 296
Uterus, Hæmodynamic Factors in the, during the Latter Part of Gestation, Dr. S. R. M. Reynolds, 546
Uwins, David (1780–1837), 517

Vaccination, Encouragement of [1837], 694
Vacuoles, Vital Coloration of the, Conditions under which Neutral Red produces the, A. Guilliermond and R. Gautheret, 40
Vacuum Tubes, Fundamentals of, Prof. A. V. Eastman (*Review*), 953
Vakuumspektroskopie, Dr. H. Bomke (*Review*), 528
Vale of White Horse, Berks, Iron Age Site in the, 1006
Veddahs, Blood-groups of, Prof. W. C. O. Hill, 548
Vegetables and Fruit in the Well-balanced Diet, Place of, Dr. G. E. Friend, 615
Vehicle Tests on Motor Roads, 888
Vektor- und Tensor-rechnung, Einführung in die, Prof. H. Schmidt (*Review*), 302
"Velan", a Water-proofing Agent for Textile Goods, 612
Venus, Mars and, Occultations of, 103
Verein deutscher Eisenhüttenleute, award of the Carl Lueg gold medal to Sir Harold Carpenter ; election of J. Henderson as an honorary member, 675
Vibration Temperature in relation to Rotation Temperature in Band Spectra, Dr. N. R. Tawde and S. A. Trivedi, 463
Victoria Nyanza, Boats of, G. W. B. Huntingford, 812
Victoria regia, Discovery of the [1837], 434
Vie, La (Encyclopédie française), Tome 4, A. Mayer (*Review*), 664
Vienna, Academy of Sciences, Annual Meeting : Prof. O. Redlich elected president ; elections ; award of the Ignaz L. Lieben prize to Drs. Marietta Blau and Hertha Wambacher, the Rudolf Wegscheider prize to Dr. O. Brunner and the Fritz Pregl prize to O. M. Haitinger, 332
Vijayalaya Cholisvaram, Temple of, in Pudukottah State, Technique of the Painting Process in the, S. Paramasivan, 198
Virus : Particles, Aggregation of, J. G. Bald and G. E. Briggs, 111 ; Proteins, Dr. R. W. G. Wyckoff, 648
Viruses, Crystalline Preparations of, F. C. Bawden and N. W. Pirie, 1018
Vision, Role of Electric, Photochemical and Diffusion Phenomena in, J. F. Schouten, 41
Visual : Freehold, Instantaneous, after Light Adaptation, S. Hecht, 83 ; Excitation, Specific Constants for, W. J. Crozier, E. Wolf and Gertrud Zerrahn-Wolf, 943
Vitamin : A_2, A Possible, Dr. J. R. Edisbury, Dr. R. A. Morton and G. W. Simpkins, 234 ; A New Scource of, Dr. J. A. Lovern, Dr. J. R. Edisbury and Dr. R. A. Morton, 276 ; E Concentrates, Constituents of, from Rice- and Wheat-germ Oils, Dr. A. R. Todd, Dr. F. Bergel, H. Waldmann and T. S. Work, 361 ; E Deficiency in the Suckling Rat, Miss M. M. O. Barrie, 426 ; P, A. Bentsáth and Prof. A. Szent-Györgyi, 426 ; P, Dr. S. S. Zilva, 588 ; C in Sweat,

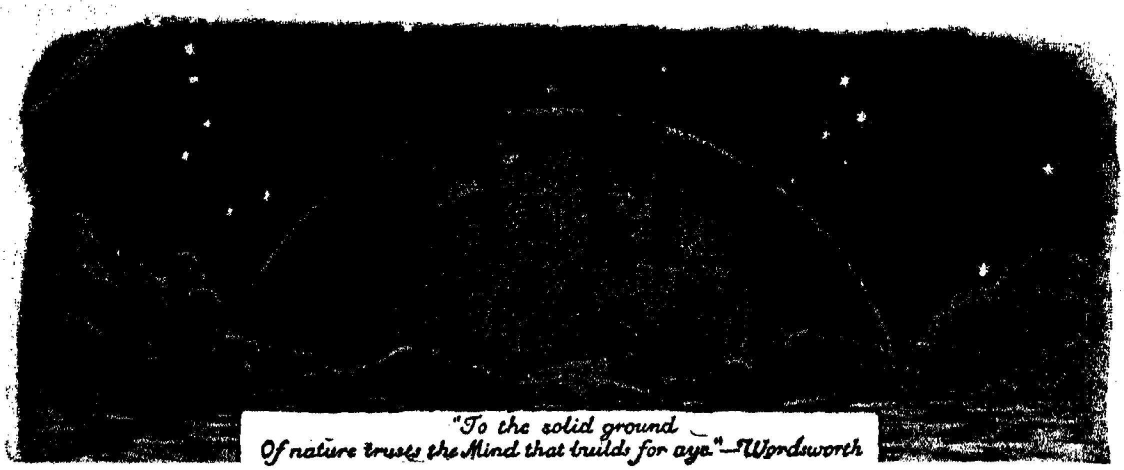
Excretion of, R. E. Bernstein$_1$, 684; B$_1$, Reduction of, A Coloured Intermediate on, F. Lipmann, 849; B$_1$, Synthesis of, J. K. Cline, R. R. Williams and J. Finkelstein, 856; B$_1$, Intermediates of, and Growth of Phycomyces, W. J. Robbins and F. Kavanagh, 943; E, Effect upon Sex Behaviour of a Diet Deficient in, Dr. B. P. Wiesner and A. L. Bacharach, 972; D, Protective Effect against Experimental Rickets of Rats of a Single Massive Dose of, Dr. H. Rotter, 973; C in the Potato, J. B. H. Ijdo, 977; A, Crystalline, H. N. Holmes and R. E. Corbet, 1020; Pellagra-Preventing, Nicotinic Acid and the, Dr. L. Harris, 1070
Vitamins in Theory and Practice, Dr. L. H. Harris. New edition (*Review*), 302
Vocational Guidance, Factors of, Dr. Oeser, 284
Volcanic Eruption, Precursors of a, R. Takahasi and T. Minakami, 470
Volkstumatlas von Niedersachsen, Dr. W. Pessler. Lief. 1 u. 2 (*Review*), 785
Voltaic Battery, Dr. Andrew Fyfe on the [1837], 333
Volumetric Analysis, A. J. Mee (*Review*), 831
Votive Offerings from Chichen Itza, Yucatan, 159

Wales, Fisheries of, C. Matheson, 721
Wallis Island, Ethnology of, E. G. Burrows, 812
Wandering Spirit: The, a Study of Human Migration, Dr. R. Numelin (Review), 89
Warren Research Fellowships, appointments to, of G. S. Hartley and J. T. Randall, 232
Washes, Egg-Killing, Kearns, Martin and Wilkins, 469
Water: and Heavy Water, Surface Tension of, J. Timmermans and H. Bodson, 293; Structure of, P. C. Cross, J. Burnham and P. A. Leighton, 512; Light and Heavy, Densities of Mixtures of, L. G. Longsworth, 900; Supply and Public Works, G. H. Thiselton-Dyer; H. Dewey, 963; E. G. Bilham; Dr. W. H. J. Vernon and Dr. F. Wormwell, 964; Light and Heavy, Overvoltage in, Prof. J. Heyrovský and Dr. J. Novák, 1022; Heavy, Adiabatic and Isothermal Compressibiltiies of, Prof. S. Bhagavantam and B. Sundara Rama Rao, 1099; Survey: Committee, Inland, Second Annual Report, 1936–37, 1106; Inland, in Great Britain, Dr. B. Cunningham, 1106
Watson, Prof. Richard, work of, Prof. J. R. Partington, 803
Way that I Went: The, an Irishman in Ireland, Dr. R. L. Praeger (*Review*), 870
Weeds, Weeds, Weeds, Sir Charles Vernon Boys (*Review*), 994
West: Indian Hurricane, A, S. Durst, 117; Middlesex Main Drainage, D. M. Watson, 733; African People, Religion and Medicine of a, Dr. R. S. Rattray (*Review*), 869; Midlands, The Pleistocene History of the, Prof. L. J. Wills, 995, 1036
Wettest Place in the British Isles, Dr. J. Glasspoole, 540.
Whales, Blue, Age and Stock of, A. H. Laurie, 201; Die ? Why do Stranded, Prof. W. A. Osborne, 1017
Whaling, International Agreement for the Regulation of, 180
Whirling Threads, Air-drag and the Equilibrium of, E. R. Goshawk, 194
White Ant, The Soul of the, E. N. Marais. With a biographical note by his son and translated by Winifred de Kok (*Review*), 622
Wicklow Hills, Map of the Glacier Lakes and Local Glaciers of the, Prof. J. K. Charlesworth, 977
Wide Horizons: Wanderings in Central Australia, R. H. Croll (*Review*), 1081
'Widmanstätten Figures", Meteorites: the number of Pultusk Stones and the spelling of, Prof. F. A. Paneth, 504, 809; Dr. L. J. Spencer, 689
Wien-Planck correction in the Calculation of the Magnitude of a Star, P. Bessier, 125
Wilson Track Photographs, Exhibition of, 941
Wireless: Signal Variations, Control of, Drs. A. L. Green and G. Builder, 70; Servicing Manual, W. T. Cocking. Third edition (*Review*), 914; Pioneers, Monuments to, 926; Waves in the Ionosphere, Annual Variation of the Absorption of, Dr. F. W. G. White and L. W. Brown, 931; Communication, Marconi School of, 1095
Wires, Internal Friction of, Dr. C. Zener, 895
'Woman: *Marriage*' in Dahomey, Dr. M. J. Herskovits, 284; The Future of, A. M. Ludovici (*Review*), 486
Wood: as Fuel for Motive Power, Utilisation of, R. Vaultrin, 59; -pulp, Bleaching of, 314; -destroying Insects, Research on, Dr. R. C. Fisher, 368
Woods on Private Estates, 817
Wool, Artificial, Production in Italy, 1090
Woolf, Arthur [1837], 736
World: Power Development, Tendencies of, Dr. E. F. Armstrong, 706; The, from a Window Garden, Grace E. Pulling, 722; Structure, Prof. E. Schrödinger (*Review*), 742; Power Conference: Vienna Sectional Meeting, 1009

X- and γ-Rays, Biological Action of, Some Quantitative Aspects of the, C. M. Scott, 936
Xenon, Krypton and, Packing Fractions of, Dr. F. W. Aston, 149
X-Ray: Microscope, The, Dr. L. v. Hámos, 30; Intensifying Screens adapted to Structure Analysis, Dr. N. H. Kolkmeijer, C. J. Krom and H. Kunst, 67; Waves, Effects of the length of, on Seeds, A. A. Bless, 83; Analysis, Two Spectrometers for, W. F. de Jong, 768; Methods in the Investigation of Failure in Service, Dr. H. J. Gough and W. Wood, 1069
X-Rays: Genetic effects of, Influence of Wave-length on, H. Fricke and M. Demerec, 519; Emission of, by Vacuum Tubes of very small dimensions, submitted to a High-frequency Current, L. Mailiet, 557; and Wool Fibre, Dr. W. T. Astbury, 1069; Biological Action of, A Theoretical Review, Prof. J. A. Crowther (Silvanus Thompson memorial lecture), 1069; in Industrial Diseases, Use of, Dr. G. Shearer, 1069; Rapid Survey of Ternary Alloy Systems by, Dr. A. J. Bradley and H. Lipson, 1069

Yale University, gift for cancer research by S. W. Childs, 21
Yeast: Pure, Practical Management of, the application and examination of Brewery, Distillery and Wine Yeasts, A. Jorgensen. Third edition, revised by A. Hansen (*Review*), 705; Phosphorus Exchange in, Prof. G. Hevesy, Dr. K. Linderstrøm-Lang and N. Nielsen, 725; Diploid and Haploid Colonies of a, Winge and Laustsen, 1104
Yellow Enzyme, Protein of, Prof. R. Kuhn and P. Desnuelle, 936
Yolk Lecithin, Origin of, L. Hahn and Prof. G. Hevesy, 1059
Young's Modulus Apparatus, J. W. Cuthbertson, 511

Zahlentheorie, additiven, Über einige neuere Fortschritte der, Prof. E. Landau (*Review*), 950
Zeiss Works, Lectures and demonstrations at the, 718
Zero to Eighty: Being my Lifetime Doings, Reflections and Inventions, also my Journey Around the Moon, Akkad Pseudoman (Dr. E. F. Northrup), (*Review*), 872
Zinc: -blende, Photo-conductivity and Phosphorescence of, Dr. A. L. Reimann, 501; in Alkaline Solution, Volumetric Micro-estimation of, C. Cimerman and P. Wenger, 737; Coatings, Methods of Testing, L. Kenworthy, 858
Zodiacal Light at a Total Solar Eclipse, The, Prof. F. J. M. Stratton, 682
Zoo, A Female Rhinoceros in the [1837], 250
Zoogeography: Fundamentals of, Dr. B. P. Uvarov (*Review*), 669; General, Prof. V. G. Heptner (*Review*), 668
Zoological: Nomenclature, Prof. T. D. A. Cockerell, 27; Society of Scotland, Progress of the, 499; Society [1837], 777; Expedition to the Oasis of Siwa, Egyptian Libya, J. Omer-Cooper, 919
Zoology and Botany, Magazine of [1837], 391


"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

No. 3531 SATURDAY, JULY 3, 1937 Vol. 140

International Co-operation in Social and Economic Problems

AT a time when confidence in the League of Nations is being sadly shaken, the progress of the International Labour Organization, as shown by the recently issued annual report, is a welcome reminder of the realities of international co-operation. The emphasis which the tragic events of the last few years has laid upon the necessity of social justice as a condition of peace, both internal and external, has brought the aims and the potentialities of the Organization into stronger relief.

Beyond question the Organization has emerged stronger, and not weaker, from the slump. Its advisory and information services have been increasingly recognized by countries all over the globe. Its activity has been more than sustained, and there was never a time when a wider prospect of constructive work could be discussed; even in membership, the withdrawal of Germany in 1933 has been offset by the entry of the United States, the U.S.S.R. and Egypt.

The outstanding features of the past year have been the success of the American Labour Conference at Santiago, which has stimulated the publication of a series of valuable monographs on economic and social conditions in South America, the Maritime Conference dealing with hours of work at sea and the World Textile Conference convened at Washington at the end of the year. Despite all political and ideological differences which impede international relations at the present time, the good will necessary for international agreement is still to be found in the social field. The technical aspects of migration problems are once again receiving attention, and a fresh start is being made in dealing with the social problems of the countryside.

What gives especial interest to the annual report prepared by Mr. H. B. Butler, director of the International Labour Office, however, is the admirable survey which he presents of the international situation as a whole. Avoiding the snare of excessive occupation with the details of the progress of the International Labour Organization itself, he gives us a balanced and impartial discussion of many of the national tendencies and policies, upon the integration of which the future of our economic and social order depends. In the present report, for example, he reviews the extent of recovery from the slump, seeks to indicate certain lessons to be learnt and to emphasize some of the main problems and tendencies at the present moment.

To-day there can be no doubt that a large measure of recovery has been accomplished, but there are widespread doubts as to the attainment of any real stability or equilibrium. Moreover, the recovery has been achieved mainly by the positive action of Governments and peoples, and this in itself affords an excellent reason for learning from experience of a slump to build barriers against the recurrence of similar catastrophes.

The evidence of recovery afforded by charts of production and unemployment is decisive. It is less convincing in statistics of world trade, and freer international trade remains one of the prime necessities if any real confidence about stability or permanence of recovery is to be felt. Only a beginning has been made in stabilizing currencies and in reducing trade barriers, and in the meantime the growth of armaments and the uneconomic activity which it represents constitute a serious threat to such recovery as has been achieved, all the more in a period of rising prosperity. Mr. Butler's survey should leave no one in doubt as to the menace which recent developments in this field present to economic and social progress until a peace system guaranteed by an effective League of Nations has been organized.

It is, however, in his discussion of the lessons of the slump and of current problems and tendencies that Mr. Butler is most suggestive. Against the uncomfortable realization that prosperity does not of itself move along a straight and even course but is inclined to proceed by upward and downward waves, he sets a firm conviction that the experience of the slump has demonstrated that man is capable of exerting a degree of control over his economic destiny. This is the more important because the buffets of economic misfortune are no longer accepted with the same docility as in the past. In fact, the demand for a national economic policy may become as insistent as was the demand for a public health policy fifty years ago.

The experience of the slump has already revolutionized the traditional view of the unemployment problem. It has disposed of the old fetish that there is no such thing as involuntary idleness, and that efforts to provide work or sustenance for the unemployed are an unjustifiable interference with the law of supply and demand. The positive value of State aid to the unemployed has been demonstrated beyond question, independently of its economic value.

Sir Josiah Stamp's recent plea for investigation of population questions finds further support in some of Mr. Butler's comments on population changes in relation to unemployment. The greater difficulty of reabsorbing displaced workers is not due entirely to the greater impact of technical change on the volume of employment ; the decline in the rate of population increase in all Western countries is a much more serious factor, which aggravates the effect of technological unemployment. Moreover, technical changes mean now not merely new vocations for the younger workers or entrants to industry, but also actual displacement of those already at work. Vocational training to an increasing extent involves the training and re-adaptation of the older workers. This situation is the more serious because, while the changing age distribution in population is increasing the supply of older and decreasing that of younger persons, the accelerating tempo of industry is constantly reducing the age of maximum efficiency and consequent demand for older workers.

The difficulty of finding employment for middle-aged workers of all types is enhanced by the natural prejudice in favour of young men and women, even in the newer and growing occupations for which middle-aged men are quite suitable, and one of the gravest dangers at the present time is that the 'hard core' of elderly unemployed will continue to grow, with serious consequences to the whole economy of social services. Fortunately, the experience of the slump provides welcome evidence of the ability of social insurance as an institution to meet the exceptional and unprecedented demands upon it and even to extend its operations. This fact, however, stresses the necessity for close attention to the effect of the changing technique of industry on the character of the insured population and to the biological changes in the composition of almost all Western populations. Only by careful investigation of the problems thus presented can we hope to secure the stability of our social insurance systems under growing pressure.

It is remarkable, in some ways, that the depression has led to increasing recognition of the value of the minimum wage, and that the dogma that the most effective way of combating depression lay in the reduction of wages has largely been refuted. At the same time, it is increasingly recognized that incomes, not wage rates, form the foundation of living standards, and considerable progress has been made in raising the standard of civilization by supplementary methods such as family allowances, educational allowances or social insurance. Equally remarkable is the fact that the problem of leisure has been accentuated, not retarded by the slump. The tendency has been towards shortening the working week and not lengthening it, as in previous slumps. The problem of leisure, whether from the point of view of holidays with pay or education, forms part of a general demand for a better and wider life which is the present trend of social progress.

Mr. Butler makes pertinent comments upon the importance of monetary policy in its international aspects, but even here he can point to evidence of the beginnings of a new monetary technique, which may assist in dealing with some of these social and economic problems in accordance with the ideal of social practice. Moreover, in the extension of Government intervention in the economic world he sees further possibilities of progress, if only the horizons of thought are widened and not limited to nationalist boundaries. He recognizes that it is almost inevitable for nations to attempt some degree of national self-sufficiency, clearly as he recognizes the dangers and disturbance to progress caused by the voluntary isolation of so large an economic unit as Germany. He reiterates the importance of foresight and planning in connexion with armaments and avoiding another depression, and the necessity for developing an adequate technique for this purpose in time.

No reader of this report can be in any doubt as to the seriousness of the consequences of certain tendencies in national policies in economic and social affairs at the present time, or to the imperative need for thorough scientific investigation of population and allied questions. Nor does Mr. Butler leave us in any reasonable doubt as to the efficiency of existing international co-operation in social and economic questions. Even the few examples he cites of recent experiments at control within national boundaries indicate how hopeful the future might be if public opinion could be stirred to demand the necessary investigation and co-operate planning. This latest report gives us a most encouraging prospect of the possibilities of social control at the very time when scientific workers have come to consider, on a scale more widely than ever, just what might be done to elaborate an adequate programme and technique.

Offence and Defence in Gas Warfare

Chemicals in War:

a Treatise on Chemical Warfare. By Dr. Augustin M. Prentiss. With Chapters on the Protection of Civil Populations and International Situation, by Major George J. B. Fisher. Pp. xviii + 739. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 45*s*.

THE author's intention in the publication of this comprehensive work is to present to the public an authentic account of a much misrepresented and misunderstood subject, to give the American point of view on chemical warfare and to trace its development from its beginning in the World War to the present time. He is well qualified to undertake such a task, as he served in the War as assistant to General Fries, who was chief of the Chemical Warfare Service of the American Expeditionary Forces, and he has been on continuous duty in the American Chemical Warfare Service ever since.

Colonel Prentiss describes in full detail all the chemical agents that were used by each of the nations engaged, and also their method of manufacture and their comparative success, and he discusses the probabilities of their future employment as well as post-War developments. He refers to the sensational articles which appear from time to time about some new super-gas, a few hundred pounds of which, dropped from aeroplanes, could destroy New York. These, he says, are invariably the figments of the imagination of writers who have neither technical nor professional knowledge, and they are found to be, when analysed, without the slightest foundation of fact. But this does not mean that there may not be much more effective chemical agents in the future, though there is little to be gained in finding them while the full possibilities of those already known remain unexploited. For example, an average of only 33 casualties resulted in the War from the use in battle of 1 ton of mustard gas, whereas it has been proved experimentally that there is enough potential poison in this quantity to kill 45 million men!

The evolution of the tactics employed in discharging gas clouds and artillery and trench mortar gas projectiles is traced, and the opinion is expressed that gas troops were more highly developed and more extensively employed by the British (the Special Brigade) than by any other nation. He also confirms the opinion held in Great Britain that the use by the French of prussic acid gas in their shells (of which four millions were filled with the substance) and by the Germans of their Blue Cross shells (of which fourteen millions were filled) were two of the major errors in the gas war. Far too many chemical agents were used in the field, and there were long delays in their production; and gas was filled into shells designed for high explosive, which, with the fuses supplied, were quite unsuitable for the purpose. In fact, a heavy price was paid for lack of pre-war preparation, and the wonder is now how the amazing results achieved were ever accomplished.

The author has some interesting remarks to offer on the gassing of cities, and he considers that the effects of volatile gases, such as phosgene, can be largely avoided by taking refuge in buildings, closing the windows and doors and seeking the upper floors. Mustard gas sprayed from aeroplanes would be much more effective, and if it reached the target aimed at, it might result in serious non-fatal casualties to all unprotected persons exposed to the vapours for a period of half an hour.

Major Fisher, also of the U.S. Chemical Warfare Service, who has written the chapter on the protection of civilian populations, is of the same opinion. He thinks that the spraying of liquid chemicals from aircraft necessitates flying at altitudes of not more than 300 ft. and the deposit of spray directly on exposed personnel; but that this task would be so difficult that the employment of such liquids in aerial attacks would be limited to the dropping of vesicant-filled containers. "All military experience with chemical warfare," he says, "shows that gas may be countered by organized protection. Careful planning and preparation to this end must, therefore, appeal to and elicit the co-operation of every public-spirited citizen." It is interesting to note that the measures he advocates are precisely those recommended in the Air Raid Precautions handbooks published by the British Home Office, namely, the utilization of designated rooms within homes or residential or commercial buildings, and sealing them as gas refuges.

There are very complete chapters on chemical defence, and in summarizing the effectiveness of chemical warfare in the field the author tabulates a great deal of information collected from all available sources to show the increasing use that was made of gas in the War and its relative value to other weapons in casualty production: gas was four to five times more effective. Each casualty required 500 lb. of high explosive or 5,000 rounds of rifle and machine-gun ammunition, whereas a casualty resulted from the firing of every 22½ mustard gas shells.

This volume contains more than seven hundred pages, and is well illustrated. It comprises a very complete and impartial study of chemical warfare in all its phases, and is therefore a valuable book of reference. C. H. FOULKES.

Organic Chemistry of Nitrogen

The Organic Chemistry of Nitrogen

By Prof. N. V. Sidgwick. New edition, revised and rewritten by T. W. J. Taylor and Dr. Wilson Baker. Pp. xix+590. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 25*s*. net.

IT is refreshing to find a book which not only is thoroughly interesting to read on account of the way in which the subject-matter is presented, but is also sufficiently comprehensive to serve, for ordinary purposes, as a reference book for the range of material treated. The second edition of N. V. Sidgwick's "Organic Chemistry of Nitrogen", which has been entirely rewritten by T. W. J. Taylor and Wilson Baker, preserves that balance between interest and comprehensiveness which made the original so valuable. These authors have, in fact, adhered closely to the plan of the first edition in dealing only with the simpler organic compounds of nitrogen, although necessarily the newer book is longer, as it presents much material only discovered since 1910, the date of the first edition. For the most part the actual chapter headings of the two books are the same: the new edition omits the chapter on derivatives of uric acid, only heterocyclic compounds which contain one nitrogen atom being treated; it omits also the subsection on the simpler alkaloids; it replaces the subsections on amino-acids and on aliphatic diazo-compounds and hydrazoic acid by separate chapters; and it treats all the carbonic acid derivatives together in one instead of two chapters.

Much of fundamental theoretical importance has happened in the twenty-seven years which have elapsed since the publication of the first edition. An old controversy in the chemistry of organic nitrogen centred around the question as to whether nitrogen could exert five valencies. The electronic theory of valency has since provided an answer to this question, leading to the formulation of nitro- and azoxy-compounds, the nitrile and amine oxides, and compounds of the type NR_5 as derivatives of quadri-covalent nitrogen.

In the introduction, Prof. Sidgwick stresses his belief that the conception of resonance is the most important development which structural chemistry has had since its extension to three dimensions by van't Hoff. Use has been made of this idea throughout the book to explain the remarkable stability of certain compounds (for example, aromatic compounds), the notable modifications often exerted by one group on the properties of another (for example, the amino- on the carbonyl group and vice versa in an amide), and generally the absence of isomers to be expected from the older structural formulæ.

As in the original book, questions of structure are treated very fully, and physical as well as chemical methods of determining configuration are discussed. Here the new edition contains much fresh matter, owing to the development of physical methods. Among these may be mentioned the use of (*a*) Raman spectra, for example, to prove the presence of traces of HN : C in HC ⋮ N, and to elucidate the structure of the *iso*cyanides, the cyanogen halides and the thiocyanate ion ; (*b*) the electron diffraction method, to prove that diazomethane has an open-chain structure ; (*c*) X-ray analysis, to show that the azide ion is linear ; (*d*) dipole moments, to distinguish between *syn*- and *anti-N*-ethers of oximes, to fix the structure of azobenzene as *trans*- and to confirm the structure of the *iso*cyanides ; (*e*) heats of formation of links from atoms, to prove the structure of the cyanogen halides.

The book should be of great value to students : for whereas, under the present system of short intensive courses, it would scarcely be possible for a science degree student to master the whole contents, yet the greater part of it may be said to be useful examination knowledge ; whilst to read the whole book cannot but be interesting and stimulating, since it shows how problems are attacked, and indicates, to some extent, further subjects requiring elucidation. To more senior people, no longer students in the technical sense, the new volume will be welcome as an old and valued friend, after long absence returned with added charm and strength. E. H. I.

Coronation Ceremonial

A History of the English Coronation
By Prof. P. E. Schramm. Translated by Leopold G. Wickham Legg. Pp. xv+283. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 12*s*. 6*d*. net.

NOW that the coronation of His Majesty King George VI is a thing of the past, it is possible to take stock of the more immediate results which have emerged. Among these not the least impressive is the manner in which it has been emphasized on all sides, as never before, that this ceremonial has a living meaning for the peoples of the British Empire. It has been, in fact, from first to last, and not merely on one day and within the Abbey walls, a solemn act of mutual dedication between king and people. In this unprecedented appreciation of the solemnity of the occasion, science has played no small part by the application of its resources to meet the needs of the occasion, especially in methods of record and transmission of news, and more particularly by the manner in which the general public has been enabled to participate in the varied ceremonial and pageantry through the development of wireless telephony and the cinematograph.

This expansion beyond the immediate scene of action in essence breaks no new ground. It follows tradition in incorporating the coronation rite in the life of the people. This has been brought out by the more serious attempts which have been made to trace the history of the observances marking the inauguration of a king in British history. Among these, Dr. Schramm's account takes its stand in the first rank, if only for its appreciation of distinctive features in a peculiar product of English methods in practical affairs.

In the matter of the English coronation, indeed, Dr. Schramm is something of an enthusiast. His book conveys the impression that not only is it pivotal in the English constitution, but also that its history is a mirror of the relations of king, church and people in domestic affairs, just as, at least in the early stages, it was made a determinant of the status of the English monarch in Continental contacts and policies. In form, Dr. Schramm holds it to be completely an expression of the English character, while in a sense it is its supreme political achievement. His study of the English royal inaugural rite falls into two sections, of which the first is a comparative history of the practices of northern Europe from the time of the earliest records, and the second contains three essays on the theory of the coronation, which deal respectively with the rite of anointing, the electoral element in the acclamation and recognition, and the contractual element in the coronation oath.

Dr. Schramm writes with an authority which is firmly based on a close study of the English coronation *ordines*. His profound knowledge of the medieval mentality towards questions of a theologico-legal nature, such as for example investiture, adds weight to his judgment in matters of doubtful interpretation; and when, as on occasion, he differs from generally accepted opinion, his verdict cannot be lightly set aside. His analysis of the development of the rite in relation to the growth of constitutional theory out of current events in the successive periods of English history is both stimulating and suggestive.

The rite, as we know it from textual evidence, is traced by the author to St. Dunstan in the tenth century, its derivation being West Frankish; but the elements of the rite, it is admitted, were of a much more ancient origin. Dr. Schramm makes the pregnant suggestion that early practice must be viewed in the light of the fact that, in the passing of possession, the Saxons made no distinction between 'public' and 'private'; while the enthronement of the heir is compared with the pagan custom of seating the one who carries on the succession on the burial mound of his predecessor as a clue to the resolution of the apparent opposition between inheritance and election. While Dr. Schamm points out that there is a magical background to the ceremonial throughout, he has barely touched on this aspect. This is the more to be regretted, as he has thereby weakened his treatment of the origins of the rite in what is otherwise an excellent study.

African Pleistocene Mammals

Wissenschaftliche Ergebnisse der Oldoway-Expedition 1913

Herausgegeben von Prof. Dr. H. Reck. Neue Folge, Heft 4. Pp. 142+8 plates. (Berlin: Dietrich Reimer, 1937.) 34 gold marks.

THE fossil remains of mammals found in the Middle Pleistocene freshwater deposits at Oldoway in Tanganyika Territory are interesting because they include several survivors from the Pliocene period, mingled with a typical modern African fauna. Primitive elephants, such as *Dinotherium* and *Mastodon*, and three-toed horses, which became extinct in Europe before the Pleistocene period, lived in east Africa until towards the end of this period, and were associated with numerous mammals which are only varieties of those still existing on the same continent. We therefore welcome another instalment of Dr. H. Reck's valuable volume on the collection of these fossil mammals which he made in 1913, and look forward to the early publication of a similar report on the second collection made in 1931 by Dr. Leakey's expedition, in which Dr. Reck also took part.

The new instalment of the German report begins with an exhaustive description of the remains of antelopes by Dr. Ernst Schwarz. For this work Dr. Schwarz found it necessary to study and compare the skeletons of the existing African antelopes more closely than they had been studied and compared before; and his observations suggest some changes in the generally accepted classification, which he discusses and tabulates. Among the fossils he recognizes only fourteen species, which are very few compared with the number of species now living round Oldoway. He also notes that some of the fossils belong to species which at present exist only farther north in Africa. With rare exceptions the fossil forms must be regarded as merely varieties of the existing species, but they are sometimes of smaller size with less developed horns. A variety of the brindled gnu is so common that it seems to have lived on the spot in large herds, and a considerable proportion of the remains belong to young individuals.

In the next two chapters Dr. W. O. Dietrich describes some fragmentary remains of pigs and giraffes, among which two teeth and a metacarpal bone of *Sivatherium* are the most interesting. The teeth were at first referred by Schlosser to *Helladotherium*, but the later discoveries by the Leakey expedition suggest that the new determination is more likely to be correct.

In another chapter Dr. A. T. Hopwood describes the remains of horses, among which the distal half of the associated three metatarsals belongs to a three-toed form like *Hipparion*. The teeth, which probably represent the same species, seem to be referable to *Stylohipparion*; this occurs fossil in the Orange Free State. With these fragments have also been found teeth and bones of ordinary one-toed horses, among which the well-preserved lower jaw of an apparently new species of zebra is noteworthy.

In a concluding chapter Dr. Reck himself describes the frontlet with horn-cores of a remarkable antelope, which seems to belong to a new extinct genus. He is to be congratulated on having thus completed the task of making known the Oldoway fossil mammals which he and his colleagues began more than twenty years ago. There now remains only the geological report, which will complete the work. A. S. W.

Annual Reports on the Progress of Chemistry for 1936

Vol. 33. Pp. 512. (London: Chemical Society, 1937.) 10*s.* 6*d.*

THE annual reports on the progress of chemistry, published by the Chemical Society, have for long tended to become collections of monographs on selected phases of the process whereby the science is advancing along the parallel paths of experiment and theory. In this way both professional chemists and other readers interested in the progress of the natural sciences can best be presented with an outline sketch of what is in reality a rapidly expanding and frequently changing picture.

The subject-matter is broadly divided into radioactivity and sub-atomic phenomena, general and physical chemistry, inorganic chemistry, crystallography, organic chemistry, biochemistry and analytical chemistry. The method of treatment may be exemplified by quoting the titles of the sections of organic chemistry, as follows: stereochemistry; carbohydrates; natural resins; aromatic compounds; dehydrogenation in the determination of structure; synthesis of polycyclic hydroaromatic compounds; natural products of the sterol group; heterocyclic compounds; alkaloids; vitamin B_1 and thiochrome. Under "Chemical Kinetics", the quantal theory of chemical change, the object of which is to predict the absolute magnitude of the velocity of chemical reactions of all kinetic orders in homogeneous and heterogeneous systems, is discussed. The chapter on atomic weights refers to the importance of establishing an invariable standard for chemical work, a requirement which has arisen from the discovery that oxygen in air is heavier than oxygen combined in water. A summary of recent work on fluorine and its compounds and on the rare earths is given; it is interesting to be reminded that the rare earths as a whole are not particularly rare, being as plentiful in Nature as lead, zinc or cobalt.

Reference is made to a new modification of insulin therapy involving the use of protamine insulinate, and considerable space is devoted to the phenomena of photosynthesis in plants, whilst the new magneto-optic method of chemical analysis is briefly criticized. Since in every case the authors are investigators of acknowledged authority, the volumes of this series are of permanent value as well as of immediate interest.

A. A. E.

An Outline of Malayan Agriculture

Compiled by D. H. Grist. (Malayan Planting Manual, No. 2.) Pp. xiii+388+86 plates. (Kuala Lumpur: Department of Agriculture, 1936.) 3 dollars.

THIS handbook, which has been prepared by the Agricultural Department in Malaya, is an enlarged and completely revised edition of one published some years ago. It supplies information on all aspects of Malayan agriculture.

The first chapters are devoted to a general discussion on agricultural conditions (including land tenure) and agricultural practice throughout the Peninsula. Part 3 of the volume deals in detail with the major crops, which are rubber, coco-nuts, rice, oil-palms and pineapples. Parts 4 and 5 are devoted to the numerous secondary and minor crops of that region, including the large groups represented by fruits, vegetables and spices. Although some of the crops or plants dealt with, such as the durian mangosteen and rambutan are typically Malayan or East Indian, most of the others are cultivated generally throughout the tropics. The book should therefore be of interest or value to agriculturalists in other parts of the tropics besides Malaya. In the section on livestock, cattle, pigs, poultry and freshwater fish are dealt with, and in the appendix there are lists of import and export duties, Malayan weights and measures and a full bibliography. A large number of photographs are used to illustrate the text.

The authentic nature of the information and the amount of detail contained in this handbook, combined with the care and thoroughness with which it has obviously been prepared, should place it in the front rank of works on tropical agriculture.

Higher School Revision Mathematics

By L. Crosland. Pp. viii+164+xviii. (London: Macmillan and Co., Ltd., 1937.) 3*s.* 6*d.*

THE usefulness of the author's "Revision Mathematics" for the First School Certificate Examination has led to a request from teachers for a similar book dealing with the pure mathematics required by the non-specialist for the Second or Higher Certificate Examination. The present volume has therefore been compiled to supply this demand.

The book provides a large number of exercises arranged in four main groups: algebra, trigonometry, geometry and calculus. Each section is introduced by some fully worked-out questions which are well chosen to illustrate the main points essential for adequate revision. The graphical illustrations are especially clear, and should lead pupils to see that, what they sometimes consider to be rather a dull part of the subject, is really very interesting and stimulating. The section on integration, too, deserves special mention for its clarity and completeness. It should certainly help to pilot the pupil through the great sea of the calculus.

The concluding section consists of a very useful set of typical examination papers illustrating the standard required by the various examining authorities.

The book is excellently adapted to its purpose, and may be confidently recommended. We notice a few errors which will no doubt be corrected in a future issue.

Quantity Surveying for Builders:

a Text-Book for Surveyors, Civil Engineers, Builders and Contractors. By Wilfrid L. Evershed. (Directly-Useful Technical Series.) Fourth edition, revised. Pp. xix+282+12 plates. (London: Chapman and Hall, Ltd., 1936.) 10*s.* 6*d.* net.

THE fact that this work has necessitated four editions in fourteen years shows that it is fulfilling a definite need. Designed to illustrate methods commonly used in the best London practice, and clearly illustrated and set out, it can be recommended with confidence not only to students of quantity surveying, but also to the practitioner.

The Synthesis of Large Molecules*

By Prof. H. Mark, University of Vienna

NORMAL molecules with which the organic chemist has been concerned for many years, and which have led to an enormous number of interesting and important chemical combinations with valuable properties, have molecular weights between 50 and 2,000. Only a very few of them are smaller and few are larger, but even then they do not exceed these limits by a considerable amount.

For some time, it has been known that certain types of chemical reactions lead to products which do not crystallize and to which therefore was attributed the name of 'resins' or 'resin-like' substances. To identify and reproduce them was very difficult; hence for a long time it was considered that they could not be taken as objects for scientific investigation. But these substances offered mechanical, thermal and electrical qualities which made them very important from the technical point of view, and interest in their structure and synthesis began to develop.

On the other hand, the study of such natural products as cellulose, proteins, rubber, starch, silk, chitin, etc., led to the conclusion that their structural principles were the same as those of the synthetic resins; and the interest in this group of bodies was intense in view of their biochemical and technical qualities. Therefore a number of scientific workers began to investigate large molecules with enthusiasm; and our knowledge of them has rapidly increased.

It was found that two types of large molecules exist, one with chain-like molecules, another with large molecules which have the structure of a two- or three-dimensional network. In both cases, the number of atoms which are held together by normal chemical main valencies is very large—between 10^3 and 10^5—and hence their molecular weight lies between 10^4 and 10^6 ($O = 16$). Several other qualities of these large molecules have been studied and cleared up; for example, their shape, reactivity, mechanical and optical behaviour, etc.

After our knowledge on the outstanding qualities of these bodies had reached a certain point, interest was aroused in that type of chemical reaction by which such macro-molecules are built up, and it is proposed to give a very short survey of the present state of evidence of this kind of chemical reactions, the so-called *polymerization* and *polycondensation* reactions.

THE POLYMERIZATION REACTION

Small organic molecules with one or more double bonds have the peculiarity of polymerizing under certain conditions of temperature, pressure, etc. This polymerization leads mostly to macromolecular substances, which are therefore also often called *high polymers* or *high polymeric* substances. Let us consider the most simple chemical molecule with a double bond, namely, ethylene and its derivatives.

In this case the total polymerization reaction (of an ethylene derivative) is given by the relation

$$n.\mathrm{CH_2{=}CH}X \longrightarrow (\mathrm{CH_2\,.\,CH}X)_n. \qquad (1)$$

In this equation, X signifies the substituent (H,CH_3,Cl,C_6H_5,OH, etc.), n is a number of the order of magnitude between 10^3 and 10^4. The left side of the equation (1) represents a great number of *independent small* molecules, each of which is completely known regarding its structure and contains a double C-C linkage. The right side gives a large molecule, the structure of which is not quite clear in all its details, which contains all the atoms contributed by the n molecules linked together by main valence bonds.

Frequently the macro-molecules built up from ethylene monomers are *chains*, and in such cases one may write equation (1) in more detail thus:

$$\begin{aligned}&n.\mathrm{CH_2{=}CH}X \longrightarrow\\&\mathrm{CH_3{-}CH}X{-}(\mathrm{CH_2{-}CH}X)_{n-2}{-}\mathrm{CH} = \mathrm{CH}X. \quad (2)\end{aligned}$$

In this case, a certain assumption is made as to the internal structure of the chain-like macromolecule, an assumption which is justified in some cases by considerable experimental evidence. Many chain polymerization processes were carried out with substances of this kind and formulated by relations of type (2), and it may be pointed out that Staudinger in Germany and Carothers in the United States especially have worked systematically in preparing macro-molecules by the aid of such processes.

Besides the material which is built up hereby, and which at first absorbed the whole attention of investigators, the *mechanism of the process* by which such long chains are formed is also of great interest and hence should be studied systematically. We have therefore in Vienna in the last five years carried out some series of experiments to elucidate the different steps of typical polymerization reactions.

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* Friday evening discourse delivered at the Royal Institution on April 23.

From the beginning, it is clear that the numerous independent particles on the left side of equation (1) cannot be linked together in *one single* collision process, which would have a vanishing probability, but that there must be a kind of growth, which builds up the long chain. This *growth process* is the aim of our studies ; it seems to be not only of scientific interest in connexion with the physical-chemical problem of reactivity, but also of technical and biochemical importance. The technical significance may be confirmed by the fact that a great number of synthetic high polymers are of considerable interest, such as artificial rubber, insulators, varnishes, etc., while the biochemical importance is indicated by the observation that our own bodies and the skeletal substances of all plants and animals are built up of high polymeric substances and that therefore the growth processes of organized Nature may be connected with the reactions studied. In any event, a profound knowledge of the simplest polymerization reactions will be indispensable for the understanding of natural growth. We thought, therefore, that it might be worth while to devote some work to a thorough investigation of the kinetics of polymerization.

The general situation was not unfavourable : the kinetics of normal chemical reactions even of a rather complicated type was cleared up recently to a considerable extent by such scientific workers as Abel, Bodenstein, Bonhoeffer, Hinshelwood, Polanyi, Rideal, Semenoff, H. S. Taylor and others. The experimental procedure is not too complicated and the methods of following gradually the rate of the process are more or less worked out. Besides our own studies (carried out in the Chemical Institute of the University in Vienna by Breitenbach, Dostal, Jorde, Marecek, Pilch, Raff, Rudorfer and Suess) in the last four or five years, authors such as Bawn, Chalmers, Flory, Melville, Norrish, Rideal, Schulz, Taylor, Vernon and others have contributed valuable results, and one can summarize the present state of our knowledge in the following way.

(1) The whole polymerization process is very *complicated*, even when only chains are built up, and depends to a high degree on such experimental conditions as temperature, pressure, solvent, presence of catalytically active bodies, etc. But in the simpler cases—and only these have been studied carefully up to date—one can always distinguish three typical steps in a reaction of this kind.

(*a*) *The building of germs or nuclei.* No polymerization can take place if there is not an *initiation process*, by which unsaturated and highly reactive 'germs' are formed. This process can be monomolecular, bimolecular or of another order, and furnishes the *centres* of growth. It consists in the fact that in a certain molecule a very high amount of activation energy or unsaturation is concentrated either by impact with another particle of high energy, or by absorption of a photon or by the formation of an intermediate combination. In any event, this *germ-building reaction* is rather slow and very dependent on the temperature or on the presence of a catalyst (including light).

This first step has been called the 'starting' process, and we can formulate a thermal bimolecular starting reaction, for example,

$$\begin{aligned}&\mathrm{CH_2{=}CH}X + \mathrm{CH_2{=}CH}X \rightarrow\\ &\qquad -\mathrm{CH_2{-}CH}X{-}\mathrm{CH_2{-}CH}X-, \qquad (a)\end{aligned}$$

where the nucleus on the right side has two free chemical main valencies and therefore represents a very high free energy. Consistent observations by different workers led to the conclusion that the *activation energy* of the starting reaction in the case of polymerization of ethylene derivatives lies between 20,000 and 30,000 cal. per mol. The reaction is therefore slow and the germs are produced with a limited velocity.

(*b*) *The reaction of growth.* If an unsaturated germ is formed in the solution, there are two possibilities for its further fate. It may collide with another molecule (monomeric substance or solvent) and be *desactivated* by the impact. In this case, the nucleus just produced is annihilated again and no polymerization is started. But the germ may also *react* with the colliding particle and, if it is a monomeric molecule, may add it according to the relation :

$$\begin{aligned}&-\mathrm{CH_2{-}CH}X{-}\mathrm{CH_2{-}CH}X- + \mathrm{CH_2} = \mathrm{CH}X \rightarrow\\ &\qquad -\mathrm{CH_2} \ldots \mathrm{CH}X- \qquad (b)\end{aligned}$$

This is a '*growth step*' and processes of this type lead to the result required, namely, to long chains, supposing that they follow one another very quickly. Really high polymeric bodies can only be formed when a slow germ production is followed by a quick growth reaction.

In fact the rate of reaction (*b*) is very much higher than that of (*a*). Measurement shows that (*b*) goes at least 10^4-fold quicker than (*a*) ; every nucleus is built, begins at once to grow, and rapidly gives a chain of considerable length. This high velocity is easily understood : the free valencies at the end of the germ and of all intermediate members of the growing chain represent a high energy, and therefore the activation energy of the addition reaction (*b*) is rather low, lying between 4,000 and 8,000 cal. per mol., and explains the rapid growth, which is nearly independent of temperature. Very interesting results concerned with the steric factor of growth would lead us much too far and cannot be considered here.

If the growing chains meet no obstacle during their period of adding monomolecular material, they will grow so long as molecules of the polymerizing substance are available, and the result of the whole process will depend only on the velocity of *germ formation*, k_1, and of *growth rate*, k_2. The competition of these two influences was discussed quantitatively by Dostal and Mark, and formulæ have been derived and compared with the experimental results. It seems that only in very special cases one can reduce the whole complicated polymerization process to these two steps alone ; mostly it is necessary to take into account a third elementary effect, which interferes with these two steps, namely, the *breaking-off* of the growth.

(*c*) *Breaking-off processes and sudden finishing of growth.* Our general knowledge of addition reactions between molecules shows that with increasing size of the reacting particles the probability for a successful collision, that is, the addition of a new member in the chain, decreases very rapidly with increased size of the molecules, even if the activation energy remains quite constant. Investigations of Evans, Eyring, Hellmann, Polanyi, Syrkin and Wassermann show that the reactivity falls off very quickly even with medium molecular weight (200–400). It is therefore to be expected that the rate of growth would be very much dependent on the actual chain length, an influence which was introduced into the formulæ by Dostal and Mark, with the consequence that the growth-rate of an individual chain falls off slowly. Comparison with experiment showed that under certain conditions the polymerization of styrene seems to be remarkably influenced by this peculiar effect.

On the other hand, one must be aware of the fact that a *third type of reaction* finishes the growth of the chains by annihilating the active groups at their ends. Thus we have to introduce a third reaction constant, k_3, which summarizes all possibilities for the saturation of the reactive spots. They are rather numerous, and it is therefore difficult to get a clear idea of the chain-breaking process.

(1) When the chains are flexible, it may happen that the two free valencies on their ends react with one another producing a ring molecule of many members. Such molecules are known from the work of Müller, Ruzicka and others, and even the kinetics of their formation was cleared up to a certain degree by Freundlich and Salomon. We do not yet know exactly how much this factor influences a given polymerization reaction, because we have no effective means of finding out how many ring molecules are present in the product of a particular polymerization reaction. In this connexion, new experimental evidence is wanted ; such a breaking-off reaction would be monomolecular.

(2) A growing system can loose its active ends, if a hydrogen atom wanders along the chain and if a double bond is formed at one end :

$$-\mathrm{CH_2{-}CH}X- \;\dots\; -\mathrm{CH_2{-}CH}X- \longrightarrow \mathrm{CH_3{-}CH}X- \;\dots\; -\mathrm{CH{=}CH}X \qquad (c)$$

The probability of such *isomerization* will be inversely proportional to the actual length of the chain, and a breaking-off reaction of this type will be of the first order, short chains being in greater danger of undergoing this isomerization than longer ones. Actually, in the case of short chains ($n=2$ or 3), the final products of this reaction could be isolated in one or two cases, but it is not yet clear what role this type of chain-cutting plays in the whole process.

(3) The annihilation of a single active group at one end of the growing thread-like molecule can also be accomplished during a collision according to the equation

$$-\,\mathrm{CH_2}\dots\mathrm{CHH^*}-\mathrm{CH}X-+M\longrightarrow -\,\mathrm{CH_2}\dots\mathrm{CH{=}CH}X+M\mathrm{H^*} \qquad (d)$$

Here the hydrogen atom H* jumps under the influence of the collision with M from the penultimate carbon atom to the colliding particle M, and a double bond is formed. Several types of this reaction have been discussed by Dostal, Flory, Mark and Schulz. The probability of such a process is proportional to the concentration of the unsaturated ends and to the concentration of M. The latter partner may be any molecule able to take up a hydrogen atom present in the reacting system, for example, a normal monomeric particle, another growing chain, a solvent molecule or any impurity of the solution. Even the wall of the vessel could produce the change expressed by the relation (*d*). Therefore it is not easy in a given case to say precisely what will happen.

An important and interesting question is : What happens to the energy which is set free by the process (*d*) ? As a new C-C bond is formed, we may estimate the energy excess of (*d*) to be about 70,000 cal. per mol. It may remain in the chain and increase its internal vibrations and rotations ; perhaps with the effect that after a certain average life-time the second end of the chain is also stabilized by a similar action. But the energy may also be transferred to M and create a highly active particle. If M is a monomeric molecule, it can be transmutated into a new germ, so that one chain is ended by (*d*) but another is started. There are signs that something like that happens under certain experimental conditions. If *M* is a solvent molecule, the energy may be dissipated by consecutive collisions, but it may also be attached to one monomeric particle in the course of reproduction of a germ with the aid of the solvent. In recent papers of Dostal, Flory, Mark, Schulz and others, these various possibilities are discussed and brought into relation with the experimental facts.

The result is that at present no polymerization process can yet be resolved quite clearly into all its elementary steps, but there is no doubt that the three above-mentioned processes, namely, chain start, chain growth, and chain ending always take the outstanding role during a polymerization reaction. Increasing experimental material will enable us to separate more and more neatly the different possible steps and to work out something like a fine structure of polymerization reactions.

POLYCONDENSATION REACTIONS

This is the second type of reaction by which high polymers can be produced. Here also we will confine ourselves to reactions which lead to pure chain polymers. In a condensation reaction a new molecule is built by removal of a part of the reactant particles ; this part is usually water. If a dibasic acid, for example, succinic acid, reacts with glycol one gets :

$$\begin{aligned}&HO.H_2C-CH_2.OH + HOOC.CH_2.CH_2.COOH \rightarrow \\ &\quad HOH_2C.CH_2O.OC.CH_2.CH_2.COOH + H_2O \qquad (e)\end{aligned}$$

This esterification leads to a molecule which can again react with an alcohol or with an acid, producing further reactive molecules and growing thus *slowly* to a long chain with alternate alcohol and acid members.

Reactions like this have been investigated recently by Dostal, Flory, Marecek, Raff and others. They are much easier to deal with because the intermediate products are not unsaturated but of the same type as the monomeric substance. It is therefore not a chain reaction, which we have before us, but a *stepwise esterification* for which kinetic formulæ can be derived without serious difficulties. The problem of the mutual interaction of three different elementary processes as it has to be solved in the case of polymerization is here reduced to the mathematical study of a step reaction with many steps. The production of 'germs' is here of the same order of magnitude as the velocity of growth, and therefore the chains which are formed are much shorter than in the case of polymerization. Therefore a fairly good agreement was obtained by comparing the results of experiments with the above-mentioned formulæ, and the problem of polycondensation reactions does not offer serious difficulties to a quantitative understanding.

This is a reason why the efforts of workers are being more and more concentrated on the study of polymerization processes, which still offer a great number of unsolved and interesting problems.

The Solar Eclipse of June 19, 1936

AN old practice was revived on May 27, when a joint meeting of the Royal Society and the Royal Astronomical Society was held to receive reports on the expeditions organized by the Joint Permanent Eclipse Committee of the two societies for the total solar eclipse of June 19, 1936. It was sad to observe that on this occasion the tradition by which the president of the Royal Astronomical Society sat facing the audience alongside the president of the Royal Society was allowed to lapse.

Prof. F. J. M. Stratton opened the discussion with an account of the expedition to Kamishari in Hokkaido, staffed from the Solar Physics Observatory, Cambridge, with the addition of Dr. T. Royds, of the Kodaikanal Observatory, sent by the Government of India. He mentioned that the site was chosen after consultation with the Meteorological Office and consideration of the data supplied by the National Research Council of Japan. Unfortunately, the prevailing wind which should have given the desired weather for the eclipse chose the wrong week to prevail, and the day of the eclipse was cloudy. The second half of the partial phase was happily clear, and Dr. Royds was enabled to carry through most of his programme successfully ; second contact was observed through gathering clouds which spoilt by scattering light the programme of observing intensities of chromospheric spectral lines at different heights above the sun's limb, though flash spectra were obtained ; within five seconds of the commencement of totality the sun was completely covered by cloud too thick even for the infra-red cameras to penetrate ; the sun did not emerge into a clear sky until 10 minutes after the end of totality.

It was unfortunate that the half of the eclipsed sun which was in clear sky for second contact and for the first few seconds of totality was on the opposite limb to that of second contact, and valuable observations were lost by a margin of seconds only in the race of moon and clouds to cover the sun. Prof. Stratton devoted his remarks to the part of the programme which was lost due to the clouds—the polarization of the coronal light to be observed by Dr. C. W. Allen with a double camera and a Nicol prism in front of one lens, and the direction of polarization of skylight in the neighbourhood of the eclipsed sun, to be observed photographically by himself and visually by Dr. F. W. Aston with a set of Nicol prisms and Savart plates. Prof. Stratton paid a tribute to the generous help and assistance received from the Japanese authorities and scientific colleagues, and mentioned that, of the three neighbouring Japanese expeditions, all of whom had a clear sky for the eclipse, one was led by Prof. Matsukuma, of Sendai University, who had stood down from his original plan to go to Kamishari to make room for the English party.

Dr. Royds next gave an account of his measures of the displacement of the Fraunhofer lines at the centre and limb of the sun's disk with and without an eclipse. His values were as follows:

Intensity of lines	Mean displacement to red			
	Without eclipse		During eclipse	
	Centre	Limb	Centre	Limb
	A.	A.	A.	A.
11·0	0·0100	0·0122	0·0078	0·0126
5·2	0·0084	0·0148	0·0088	0·0151
3·0	0·0050	0·0122	0·0058	0·0116

It was clear from Dr. Royds' eclipse observations that the values obtained from the limb without eclipse had not been seriously affected by light scattered from the bright centre of the disk, which would especially affect the weak lines. Observations had been made at distances from the centre of the sun's disk of 0, 0·28, 0·57, 0·76, 0·90, 0·95, 0·97 times the sun's radius: the observation at 0·992 and the hoped-for observation of chromospheric lines were lost owing to clouds. The explanation in terms of convection currents for lines of different intensities originating at different levels in the sun, which had been offered for the discrepancies at the centre of the sun, could not hold for the limb, and the divergencies from the predicted Einstein displacements had yet to be explained.

Dr. R. O. Redman discussed the advantages from spectrophotometry of the chromosphere of a jumping slit spectrograph (taking a series of exposures with a fixed plate) over a continuously moving slitless spectrograph: there was less trouble from scattered light, higher resolution, greater purity of spectrum, and no trouble such as arises from the varying width of the steadily narrowing crescent photographed with the slitless instrument. He described the moving back camera specially designed by Mr. C. R. Davidson and himself for the eclipse, the instrumental setup, and the programme of exposures at intervals of one second carried out at the eclipse through second contact. As defined by the final disappearance of the Fraunhofer spectrum, totality commenced 1 second late on the computed time.

Dr. A. D. Thackeray gave an account of the flash spectra secured by Dr. Redman with the moving plate camera and by himself with the Hills quartz spectrograph fed by light from an aluminized mirror. While in both cases the original plan of observing the changes of intensity of spectral lines with solar heights had to be abandoned because of light scattering by the clouds, yet much of value could be learned from the plates. In particular, Dr. Redman's spectra included one of the finest for the study of the transition from absorption to emission spectra that had ever been secured. He directed attention to the following points of special interest: (*a*) the presence of a bright line at 3969·40 A. between $H\epsilon$ and [H] never previously recorded in flash spectra and evidence of the excellent definition secured by Dr. Redman; (*b*) the presence in absorption of the subordinate series $3^2P^\circ - n^2S$ of Na at a stage where the D lines had practically vanished in transition from absorption to emission; (*c*) the displacement towards the violet of emission lines compared with the absorption lines in a spectrum taken at a distance 0·9994 r from the centre of the sun's disk; (*d*) the gradient of the Balmer series in emission from Hβ to H26, with a value of lower weight for the total emission of Hα: the gradient showed manifest departure from the values given by the Schrödinger-Pauli formula, as had been found by Davidson and Stratton in the 1926 eclipse.

Prof. J. A. Carroll described the equipment of the expedition from Aberdeen to Omsk: the objective interferometer prepared for a monochromatic image of the whole corona crossed by interference rings which should show by their displacements internal movements in the corona; a high-dispersion echelon spectroscope with 35 plates immersed in fluid and giving an effective thickness to each plate of 1 mm. in air; and a spectrograph for the extreme infra-red spectra of the corona and chromosphere. He then dealt in detail with the method of reducing the daily range of temperature of 12° C. to the range that could be allowed without loss of definition for the instruments, 0·1° for lenses and prisms, 0.01° for the interferometer and 0·001° for the echelon. Large thermal inertia in the optical parts and small and slow changes in the surround of each instrument were required. The hut was doubled-walled and lagged inside; it was also equipped with heating and refrigerating plant controlled by thermostats and by fans for stirring the atmosphere. The instruments in their turn were surrounded by a further lagged cover with again a thermostatically controlled heating circuit inside. This first serious attempt at delicate temperature control under eclipse camp conditions had worked very successfully.

Mr. E. G. Williams spoke of the results obtained with the infra-red spectrograph. A composite plate had been used of special rapid panchromatic for 5800–6700 A., Agfa 800 for the 8000 region and Agfa 950 for the region beyond 9000 A. It had been intended to use Agfa 1050 for the region beyond 10,000 A., but though the plates were specially flown over from Berlin to Moscow they were no longer sensitive when the day of eclipse arrived and could not be used. They were, therefore, unable to secure the lines at 10,746·80 A., 10,797·95 A. recently reported by Iyot. They did get a line at 7591·3 A. in the coronal spectrum for which Curtis and Babcock in 1928 gave the wave-length 7896 A. and Iyot more recently from the Pic du Midi gave 7891·9 A. No trace was found of the line about 9609 A. to be expected if the coronal spectrum came from a doubly excited helium atom. In the chromospheric spectrum lines of the Paschen series were obtained, for the first time at an eclipse, from *P*4 to *P*17, and other lines were identified as due to He, O, Mg and Ca^+.

In the subsequent discussion Mr. J. Evershed, referring to Dr. Royds' excellent spectra, pointed out that to reduce his shifts from an arc in air to an arc *in vacuo* meant an increase of 0·003 A. and meant that the displacement at the limb was twice the predicted Einstein value. Prof. A. Fowler, in sympathizing with the Cambridge party on their failure, said that it was a magnificent failure. He was very much impressed by the mechanism of Dr. Redman's camera and with the very interesting and beautiful results he had obtained. He would also like to congratulate Mr. Williams on his infra-red spectra.

Obituary Notices

Prof. A. G. Perkin, F.R.S.

PROF. A. G. PERKIN died at his Leeds residence on May 30. Born at Sudbury, Middlesex, in December 1861, he was the second son of the late Sir William Perkin, brother of the late W. H. Perkin, jun., Waynflete professor of chemistry in the University of Oxford, and half-brother of the late Dr. F. M. Perkin, who was well known as a consulting chemist.

A. G. Perkin grew up in an atmosphere of chemistry and zeal for scientific investigation. His education was varied: he followed in his father's footsteps by attending the City of London School, and from 1877 until 1879 studied under Frankland and Guthrie at the Royal College of Chemistry, South Kensington, where he carried out the investigation leading to his first paper, "The Action of Nitric Acid on Di-*p*-tolylguanidine", communicated to the Chemical Society in 1880. He next spent a year at Anderson's College, Glasgow, under E. J. Mills, and finally a year in the Dyeing Department, Yorkshire College, Leeds, where he worked with J. J. Hummel on new compounds derived from the colouring matters of brazilwood and logwood. Perkin always paid generous tribute to the abilities and personality of Prof. Hummel, to whom he owed his first, and lasting, enthusiasm for the study of the natural colouring matters.

In 1882 Perkin left the Yorkshire College to take up an appointment as chemist at the alizarin factory of Hardman and Holden, Ltd., Manchester, and was promoted to the position of manager in 1888. During this commercial period he continued scientific investigations and published papers on the action of nitric acid on anthracene, and in collaboration with W. H. Perkin, jun., on derivatives of anthraquinone, and on the colouring matter of the Indian dyestuff, kamala.

Perkin resigned his position with Hardman and Holden, Ltd., in 1892 to join the staff of the Dyeing Department, Yorkshire College, as lecturer and research chemist. Then followed a period of more than twenty years of intensive research, mainly concerned with the isolation of the colouring principles of natural products and the investigation of their constitutions. The profound knowledge of natural colouring matters that he gained by his brilliant researches established his international reputation in this field. He examined numerous natural colouring matters by degradative methods, and in certain instances deduced their constitutions, many of which, for example, those of catechin, luteolin, gossypetin, quercetagetin, etc., have since been confirmed synthetically by other workers.

In later years, Perkin devoted more of his time to the chemistry of anthraquinone derivatives. A study of the migration of the acyl group in partially acylated phenolic compounds led to the synthesis of, *inter alia*, some hydroxyanthraquinone methyl ethers, originally isolated from the Indian natural dyestuff, chay root, but not hitherto obtained synthetically. The constitutions of numerous hydroxyanthranols were established by conversion into corresponding benzanthrones and examination of the methylation products of the latter. The formation of hydroxyanthracenes, -dianthrones, -dianthraquinones, -dianthraquinonyls and -helianthrones also was investigated and the constitutions of these compounds established.

Perkin's original papers, including those published in the *Proceedings of the Chemical Society*, all of which did not appear afterwards more comprehensively in the *Transactions*, exceeded 270. He was also author of numerous articles on natural colouring matters in "Thorpe's Dictionary of Applied Chemistry", and, in collaboration with Dr. A. E. Everest, he published the classical monograph "The Natural Organic Colouring Matters" in 1918.

Perkin was elected a fellow of the Institute of Chemistry in 1887, a fellow of the Royal Society of Edinburgh in 1893, a fellow of the Royal Society in 1903, and was awarded the Davy Medal of the Royal Society in 1924. He was also a vice-president of the Society of Dyers and Colourists, and a member of the Biochemical Society, the Chemical Society, the Pharmaceutical Society, Society of Chemical Industry, the Textile Institute, and the Livery of the Worshipful Company of Leathersellers.

In 1916, Perkin succeeded A. G. Green as professor of colour chemistry and dyeing in the University of Leeds. During the Great War he carried out investigations for the Ministry of Munitions, and also directed the work on intermediates and synthetic dyes carried out by the colony of research chemists of British Dyes Ltd. in his Department.

During his professorship, Perkin did much to widen the fundamental education of his undergraduates and to enhance the reputation of his Department as a scientific training ground for recruits for the dyestuffs, dyeing and allied industries. The very large number of students who entered for courses in colour chemistry and dyeing in the immediate post-War years were attracted at least as much by the opportunity of working under him as by the popular appeal of these subjects at that time. His students were very successful in securing appointments on completion of their courses and most of them now occupy important positions in industry.

Perkin exerted a profound, but unobtrusive, influence on his colleagues and students. He was a very gentle man with a most charming and lovable personality. He did most of his work with his own hands, and it was a privilege to observe him at work in his laboratory. He was not only a great chemist in his generation, but also he was so imbued with a passionate zeal for unravelling the secrets of Nature that all who came in contact with him were inspired by his pioneering spirit.

On his retirement in 1926, Perkin was accorded the title of emeritus professor, and in 1927 the University of Leeds conferred upon him the degree of D.Sc., *honoris causa*. In fact, he never retired, for he continued to prosecute his researches without any interruption in the professor's laboratory in the Colour Chemistry and Dyeing Department of the University of Leeds until his health began to fail in February this year. At that time he was endeavouring to determine the constitution of a green vat dye which he had obtained some years previously by heating the hydroxylated anthranol, derived from alizarin, with tetrachlorothiophen and an alkylating agent.

Perkin was well known in the Isle of Man, for many years spending all vacations at his house at Port Erin, and he was a governor of King William's College. He was very fond of animals and took the greatest interest in his dogs, his pony and his tortoise. He also inherited a great love of music, and was an accomplished performer on the flute and bassoon; he was a leading member of amateur orchestras in Yorkshire. He married Annie, daughter of the late J. E. Bedford, of Leeds, who survives him. There were no children.

E. J. CROSS
F. M. ROWE.

Prof. S. H. Langdon, F.B.A.

THE study of Assyriology must nowadays be held to embrace, in principle, the whole of the archæology, history, culture and languages of ancient western Asia. In this immense field the labourers are still few, and no country can at present boast more than a handful of them. The loss of any one is therefore serious, since replacement, much less reinforcement, is problematical. That loss is the more sensible when so active a worker as Prof. S. H. Langdon, professor of Assyriology in the University of Oxford, is withdrawn by death, on May 19, at the early age of sixty-one years.

Since the boundaries of the study have been so vastly extended by recent discovery, it has become inevitable in Assyriology, as in other sciences, that a man should specialize. Langdon's chosen branch was Sumerian, the primitive language of Babylonia, virtually extinct by the end of the third millennium B.C., but of paramount importance as belonging to a people who have been revealed, time and again, as the originators of most of the vital elements in the whole pre-Hellenic culture of western Asia. At the time when Langdon was beginning his career, knowledge of this language had scarcely passed the stage of entire dependence upon the translations furnished in bilingual texts by late Assyrian scribes, while the scepticism of Halévy still preoccupied the minds of many. Some of Langdon's early work, however, was devoted to the Sumerian religious texts without Semitic translation which have survived in large numbers, and because of their great difficulty of interpretation still remain to-day among the obscurest parts of the literature written in cuneiform.

This observation is, of course, in itself a criticism of Langdon's achievement, for throughout his working life it was upon these texts that his abundant energy was mainly concentrated; editions of the originals and translations make up a large part of his bibliography, whereas few of his contemporaries cared to venture upon so hazardous a ground. But it must be owned that, in the editions, his copies were not always of the most reliable, and that he failed to detect this and other faults in his translations (though never unready to admit mistakes) chiefly because of a certain lack in comprehension of the practical sense of a phrase or of a text, and this allowed him too often to put forward merely verbal translations. It must be remembered, however, that some of the literature to which he devoted himself is jejune in content, and must necessarily look rather absurd in the baldness of translation. How carefully he had prepared himself for this work is shown by his "Sumerian Grammar" (1911), which, if it cannot be said to have marked a decisive advance, has the credit of being the first full-length treatment of the subject.

To the study of the Akkadian (Semitic) language, which is better known, Langdon's contributions were less copious. But he has to his credit at least one book which is still a standard work of reference, "Die neubabylonischen Königsinschriften" (1912) and, despite certain oddities, his "Babylonian Epic of Creation" (1923) contains much which subsequent translators have been glad to use. Besides one or two philological books of less importance he wrote in 1931 a general work on "Semitic Mythology" which, somewhat belying its name, drew very largely upon the Sumerian religious literature which he knew so well. But many will think that one of Langdon's most remarkable achievements was that he, essentially a man of the study who had hitherto shown little interest in archæology, seized the opportunity after the Great War to excavate in Iraq, and with great enthusiasm proposed, organized, and even raised part of the money for, an expedition which made important discoveries at Kish. He himself spent two seasons on the site, much to the detriment of his health, and afterwards began two series of volumes devoted to the archæological and epigraphical results of the work. In his latest years he often spoke of a Sumerian dictionary which he had long been preparing, and he had announced a future edition of the Assyrian texts upon which his recent Schweich lectures were based.

WE regret to announce the following deaths:

Prof. A. Erman, formerly director of the Egyptian Section of the Berlin Museum, and professor of Egyptology in the University, on June 26, aged eighty-three years.

Dr. H. H. Jeffcott, secretary of the Institution of Civil Engineers, on June 29.

Prof. T. Mather, F.R.S., emeritus professor of electrical engineering in the City and Guilds (Engineering) College, Imperial College of Science and Technology, on June 23, aged eighty-one years.

News and Views

Queen Mary and the Bodleian Extension

QUEEN MARY was given a warm and affectionate welcome when, on June 25, in royal weather, she visited Oxford to lay the foundation-stone of the great Bodleian extension to be erected in Broad Street opposite the Clarendon Building. A special Convocation of members of the University was held in the Sheldonian Theatre to which the public were admitted without ticket, and which was so filled in every part that although no one was turned away, twenty more could not have been accommodated in comfort. There an address of thanks was presented to Queen Mary by the Chancellor, Lord Halifax, and the Vice-Chancellor, the Master of Balliol. They spoke of how proud Oxford is of its ancient, Bodleian library, and how urgent it is for the work now being done in all branches of teaching and research that it should be properly maintained and extended. The Queen then crossed Broad Street to a stand raised above the enormous hole in the ground which is at present the site. There was assembled another large party representative of Oxford life, academic and civic, and of those entrusted with the erection of the building, Sir Giles Gilbert Scott, the architect, was present. The Queen then laid the foundation-stone on which the following words have been inscribed:

AEDIFICII NOVI BODLEIANI
HVNC PRIMVM LAPIDEM
POSVIT MARIA REGINA
REGIS GEORGII VI MATER
DIE XXV MENS. IVN. A.D. MCMXXXVII

Prof. F. Wood Jones, F.R.S.

PROF. FREDERIC WOOD JONES, at present professor of anatomy in the University of Melbourne, has accepted an invitation to fill the chair of anatomy in the University of Manchester, in succession to Prof. J. S. B. Stopford, who has asked to be relieved of the duties of the chair, in view of the increasing responsibilities of his administrative work as vice-chancellor of the University. Prof. Wood Jones graduated in science in the University of London in 1903, and in medicine and surgery in 1904. In 1910 he was awarded the degree of D.Sc. in zoology of the University of London. He was elected to the Royal Society in 1925 and to the fellowship of the Royal College of Surgeons in 1930. Prof. Wood Jones has held professorial chairs in the London School of Medicine for Women (anatomy) and in the Universities of Adelaide (anatomy), and Hawaii (physical anthropology) in addition to the chair of anatomy at Melbourne, to which he was appointed in 1930. In 1932–33 he acted as temporary director of the Peiping Union Medical College. His experience in other fields includes the duties of a medical officer in the Far East, anthropologist to the Egyptian Government, and membership of the Archæological Survey of Nubia. On four occasions he has delivered the Arris and Gale Lectures of the Royal College of Surgeons. Among his numerous published works are "Coral and Atolls", "Arboreal Man", "The Mammals of South Australia" and "Man's Place among the Mammals".

Sir Morell Mackenzie (1837-1892)

SIR MORELL MACKENZIE, the eminent throat specialist of the Victorian era, was born at Leytonstone, Essex, on July 7, 1837. He came of a medical family, his father being a distinguished general practitioner, and his younger brother Stephen a prominent physician on the staff of the London Hospital. After qualifying in 1858, he went to Paris, where he attended the clinics of Trousseau, Nelaton, Ricord and others, and then to Vienna, where he studied under Oppolzer, Skoda, Rokitansky and Hebra, and finally to Budapest, where he made the acquaintance of Czermak, who was experimenting with the laryngoscope invented by Manuel Garcia. On his return to London, after holding the posts of resident medical officer and registrar at the London Hospital, he set up in practice in George Street, Hanover Square. In 1863 he gained the Jackson prize of the Royal College of Surgeons by an essay on the pathology and treatment of diseases of the larynx and in 1866 was appointed assistant physician to the London Hospital, becoming full physician in 1873. His chief publication was his work on "Diseases of the Throat and Nose", of which the first volume appeared in 1880 and the second in 1884, and at once became the standard book on the subject. He was also the author of "The Use of the Laryngoscope in Diseases of the Throat" (1865), "Diphtheria: Its Nature and Treatment" (1879) and "Hay Fever and Paroxysmal Sneezing", of which the fourth edition was published in 1887.

MACKENZIE's eminence as a specialist won him many distinctions. He was elected an honorary member of the medical societies of Vienna, Budapest and Prague and one of the two foreign honorary fellows of the American Laryngological Association. In 1887 he was knighted, and in 1888 he received the Grand Cross and Star of the Royal Order of Hohenzollern for his attendance on the Emperor Frederick, the story of whose illness he relates in the book entitled "The Last Illness of Frederick the Noble", for which he incurred the censure of the Royal Colleges. Though a strong advocate for specialism in medicine, as he showed by two articles published in the *Fortnightly Review* in 1885, Mackenzie always maintained that a very complete medical training should be the basis of education for the specialist. Apart from his literary work, Mackenzie deserves to be remembered for his addition of a large number of instruments to the armamentarium of throat surgery and his skill as an operator in the removal of laryngeal growths. Like many other celebrated men, Mackenzie was the subject of asthma, from which he suffered for thirty years, and his death at the comparatively early age of fifty-five years took place on February 3, 1892.

Acculturation and Native Policy

IN commenting on the recent debate in the House of Lords on policy in native administration in the Empire (see NATURE, June 26, p. 1083) it was urged that the contribution of anthropological science should not be overlooked when the possible effect of administrative action, and its bearing on future policy were under consideration. A concrete example of the results which may be expected to emerge from such scientific investigation of the effects of cultural impact on a relatively simple people is afforded in a study by Prof. I. Schapera of the BaKxatla, a Bantu-speaking people, who migrated from the western Transvaal to evade the Boers about 1840 and settled in what afterwards became the Bechuanaland Protectorate. Here their earlier contact with Western civilization was continued, at first through missionaries, and afterwards through traders and administrative officials. Prof. Schapera in this study ("Contributions of Western Civilization to Modern Kxatla Culture", *Trans. Roy. Soc. S. Africa*, **24**, 3) analyses both the acceptances and the rejections by the BaKxatla of elements of Western culture and their consequences, with the somewhat remarkable result that he finds that, while some traditional elements of their own culture are retained and new elements from Western culture are incorporated with little change, an entirely novel cultural pattern is also growing up out of the contact. His paper must be consulted for details, but one instance may be mentioned. As a result of the introduction of Christianity, ancestor worship has virtually died out, but magic is retained. At the same time, the Christianity which is their official religion has come to be something very different from the doctrine as it was first introduced among them. Although it is not possible to generalize from one African tribe to another without testing the premises of the argument, it is clear that investigation on these lines has been shown to be essential before the risk is run of making any fundamental changes of principle or detail in policy.

School of Colonial Administration at Oxford

ANTHROPOLOGISTS will be afforded an opportunity of bringing these and kindred matters to the notice of administrative officers of the Colonial Services at the Oxford University Summer School of Colonial Administration, which will meet at St. Hugh's College, Oxford on July 3-17. The arrangements have been made in connexion with the Social Studies Research Committee of the University. The School is intended primarily for the benefit of members of the Colonial Administrative Services, more especially, though not exclusively, those serving in Africa. The problems of native administration in tropical Africa will be discussed in a series of lectures, in which they will be brought into relation on broad lines with world problems of economics and politics; while the experience of other countries in tropical administration in relation to such matters as local government, education, elementary and adult, the co-operative movement and the like will be demonstrated. Leading foreign experts will lecture on a number of other topics, and more especially on methods of native administration in territories under other than British rule. The School will be opened by the Right Hon. W. G. A. Ormsby-Gore on July 4, and on the same day an inaugural address will be delivered by Lord Lugard. Among those who have promised to take part in the proceedings and discussions are Sir Alfred Zimmern, Sir Arthur Salter, Lord Lothian, the Warden of All Souls, and Sir Donald Cameron. A number of anthropologists have been invited to join in the discussions and talks, dealing with problems affecting administration in different regions and from different aspects. About one hundred and seventy officers on leave have intimated their intention of attending the School. Although not 'official', the School has had the cordial support and assistance of the Colonial Office.

An Astronomical Jubilee

La Société Astronomique de France, the creation of Camille Flammarion, who did so much to popularize astronomy in France, has recently celebrated its jubilee. The chief event in the festivities which were held to commemorate the occasion was a great reception on June 16 in the Great Theatre of the Sorbonne, at which nearly three thousand people were present; the President of the French Republic attended and the Minister of Education, M. Jean Zay, presided. M. Jules Baillaud, the present president of the Society, gave an account of the history of the Society and of the work done for it successively by Camille Flammarion and his widow. After a short address by the Minister of Education, Prof. C. Fabry gave a charming account of the progress or revolution in the astronomical outlook in the past fifty years, and some beautiful slides which had been taken by Mr. Ritchey and by M. de Kerolyr at Fourcalquier were shown by M. Baldet. A film was shown of Camille Flammarion's activities in connexion with the Society, and a recorded speech of his was repeated to the audience. A concert followed in which artists from the Opera assisted, while at an earlier stage artists from the Comédie-Française and elsewhere recited poems and read extracts from Camille Flammarion's works. A memorable evening, such as could scarcely have been held anywhere outside Paris, concluded with some ballets danced by pupils of the late Loïe Fuller.

The celebrations were attended by astronomers from Belgium, Czechoslovakia, Denmark, Great Britain, Italy and the United States to add their greetings and congratulations to the Society, its president and its secretary, Madame Camille Flammarion. Opportunity was taken of the presence of many astronomers in Paris for a discussion on various aspects of the problem of interstellar matter in space, which is to be the subject of a conference in Paris on July 11-17 at the Institut Henri-Poincaré. Messrs. M. G. Darmois, J. Baillaud, Lacroute, F. Perrin, Chalonge, Barbier and Mineur gave an account of the present state of our knowledge on interstellar calcium, absorption in space, the structure of the galaxy, the nature and distribution of absorbing clouds and their effect on stellar spectra and colour indices.

Covent Garden Laboratory

For the last eleven years, contact has been maintained between the work of the Department of Scientific and Industrial Research on the transport and storage of food and an important branch of industry through the Department's Covent Garden Laboratory in Endell Street, London. This Laboratory has provided an excellent place for keeping under survey the condition of produce passing through our markets generally and for diagnosing or tracing to their source the different types of wastage and deterioration in fruit and vegetables. Samples of fruits showing wastage or abnormal features are collected from the market or are brought to the Laboratory by salesmen. Often the trouble can be diagnosed at once, but sometimes it is desirable to get the diagnosis confirmed by the Low Temperature Research Station at Cambridge or the Ditton Laboratory. The Covent Garden Laboratory also receives for examination samples of consignments of fruits new or comparatively new to Great Britain, such as mangoes, mangosteens and papaws. The interest taken in this work has now made it necessary to leave Endell Street for larger premises, which were opened by Sir Frank Smith on June 28. These are situated on the top floor of Nos. 9-13 Kean Street.

The new accommodation includes two chemical laboratories, a large 'ice box' for cooling fruit to −30° F. and three cold stores. One, maintained at 34° F., will be used for delaying ripening and for observations on apples; another at 45° F. for work on citrus fruits, and the third at 65° F. will be used as a conditioning room for initiating ripening. The two colder stores will also be used for studying the advantages of temporary cold storage for wholesalers or retailers, that is, storage of, say, mushrooms and melons for short periods. In the chemical laboratories estimations of the sugar and acid content of the fruit will be carried out. The sugar content of apples, of course, varies between individual specimens, and to get a representative sample the apples are frozen solid and then ground up into a fine powder. Another important measurement to be made is the rate of respiration of the fruit. This not only gives an indication of the age of the apple, but also is important in connexion with research which is being carried out on the mechanism by which sugar breaks down to carbon dioxide. The alcohol content of apples increases as they grow older, and this is also a subject of measurement, as it is hoped that this factor will prove an important diagnostic indication. Produce from the Empire overseas is inspected before being shipped in order that nothing may be exported which is not up to standard. Facilities will be available at the new Laboratory for officers of the Dominions and Colonies engaged in following up this work.

Medicine Stamp Duties

Duties in respect of medicines were first imposed so far back as 1783. The tax then was twofold, as it is to-day. It was imposed on all persons who sold medicines, not being doctors, apothecaries, etc., and secondly a duty was 'laid on the medicines' themselves when sold by such persons. A Select Committee was appointed in November 1936 to consider the duties of excise chargeable under the Acts of 1802, 1804 and 1812, and any amendments thereto, and to report thereon and to make recommendations, and its report has now been issued (London: H.M. Stationery Office, 1937; price 3*d.* net). Complete abolition of these duties has been advocated, but the Committee recommends that the duties ought to continue and should apply to a wider field, and bring in a much larger revenue. At the same time, it recommends that the duty should be at the rate of twopence instead of threepence in the shilling, and should be graduated less steeply. The recommendations are of a far-reaching character, and bring in everything that looks like a drug or smells like one. As drafted, it would even seem that medicines prescribed or dispensed by medical practitioners are included, though it can scarcely be believed that this was intended. The Committee also sees no reason why the "modern chemist" should have "a very valuable preference" in the sale of preparations which claim the "known, admitted, and approved remedy" exemption which has hitherto enabled them to sell unstamped certain types of preparations liable to duty if sold by ordinary shopkeepers. Despite defects, the recommendations are on the whole in the interests of the public, and with certain amendments should prove acceptable.

Acquisitions at the British Museum (Natural History)

H.M. THE KING has presented to the Museum an exceptionally fine specimen of a black leopard from India. The skin is very dark and the spots are scarcely visible in certain lights. In March 1936, Mr. H. St. J. B. Philby set out on a journey through the districts of Asir and Najram in Arabia, returning to Jidda in the early part of this year. During this trip, Mr. Philby made large natural history collections which he has presented to the Museum. Apart from the birds which number 747 specimens belonging to some 100 species, the collections include mammals, reptiles, fishes, mollusca, a large number of insects, 230 botanical specimens, some minerals, and about 400 rocks. Among the birds, three are new to science, namely, a race of the common magpie, a small Scops owl, and an emerald cuckoo. His collection includes a number of eggs previously unknown. The Department of Entomology has received from Mrs. Tillyard a collection of 500 mayflies and 700 dragonflies which formed part of the late Dr. R. J. Tillyard's collection. Among the dragonflies are included the type specimens of 105 species, and among the mayflies of 8 species. This gift is perhaps the most valuable addition to the Museum collections in these groups that has been received for many years. Accessions to the Department of Geology include a collection of about 20,000 fossil invertebrates (including 60 type and figured specimens) from the Ordovician and Silurian strata of the Girvan district of Ayrshire. The collection was made by the late Mrs. Robert Gray of Edinburgh and her daughters. Mr. F. N. Ashcroft has presented a further series of 747 specimens from his collection of Swiss minerals.

Repton School Science Society

AT the triennial conversazione of the Repton School Science Society on June 25 and 26, some forty demonstrations were shown. In the biology section, a way of recording the heart beat of a frog and the effect of stimulation by nerves, by electricity and by drugs, was shown and also a collection of local zoological and botanical specimens. Recent developments in chemical industry were illustrated by the moulding of bakelite cups in a home-made electrically-heated press producing a pressure of 1½ tons per sq. in., by the manufacture of rubber gloves from the latex by a simple dipping process using an experimental plant, and by electro-plating and bronzing on a semi-technical scale. A lecture was given in the physics section on electrical illumination, dealing with the development of lighting from the carbon filament lamp to the modern vapour discharge lamps. There were also demonstrations of a way of eliminating dazzle from motor-car headlights using the new polaroid screens and of a home-made model railway fitted with a system of automatic signalling and train control.

Scientific and Industrial Research in Australia

THE tenth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia, covers the year ended June 30, 1936, and in addition to reports on the five main divisions of the Council's work, refers to co-operation in research with New Zealand and to the meetings of the Standing Committee of Agriculture appointed as an advisory body to the Australian Council of Agriculture established in 1934 (Canberra: Government Printer, 1936. 4*s.*). Numerous reports to this Committee were furnished by the Council of Scientific and Industrial Research, dealing with such subjects as codling moth pest, survey of potato virus diseases, tobacco investigations, seed testing, weed pest investigations, soil drift, grasshopper investigations, etc. The Council also acts as a liaison with the Commonwealth Government on behalf of the Standards Association of Australia, and in this capacity provided reports on standardization of wearing parts of agricultural machinery, primary products, dusting sulphur, wire-netting and other galvanized products. During the year, the activities of the Council were extended to cover investigations into the problems of Australia's secondary industries, and a special committee has been set up to define the field and make recommendations regarding problems for investigation and the staff and organization required. A new Forest Products Laboratory approached completion during the year. This Division completed a full investigation of the veneer and plywood industry in Queensland with special reference to gluing practice, which has already led to a marked improvement in the quality of the products.

THE Division of Plant Industry has been responsible for work on the control of downy mildew of tobacco by benzene vapour in covered seed beds; this has made possible the prevention of a most destructive disease which previously resisted all attempts at control. Considerable progress in the investigation on the control of the peach moth is reported by the Division of Economic Entomology and very favourable results have been obtained with nicotine-bentonite-sulphur sprays. The same Division has been responsible for work on termite control, while the work carried out on the control of weeds has been considerably extended by reorganizing the botanical and entomological phases in one section under joint control of the chiefs of the two Divisions. The Division of Animal Health Nutrition has been responsible for investigations on pleuro-pneumonia in cattle and on the treatment of internal parasites of sheep, while its fundamental investigations on the nutrition of sheep have already led to an increase of nearly 150 per cent in the yield of wool as well as to a remarkable variation in its character. Valuable contributions to viticulture and regarding the role of organic matter in plant nutrition have been made by the Soils Division, while the Food Preservation Section has obtained promising results in investigations on the storage of peaches and plums from the point of view of export to Great Britain which should decrease the wastage in export. The Radio Research Board has continued its investigations; appreciable advance in the control and eradication of prickly pear by biological methods is again reported, and a programme of fisheries research has also recently been initiated.

National and International Standardization

REALIZATION of the advantages of standardization of industrial materials and requirements has led in most of the industrially developed countries to the establishment of organizations to promote such standardization, and already a high degree of standardization has been reached in many countries. A most informative account of the work of the various national authoritative bodies engaged in this work is given in "A Survey of the Present Organization of Standardization—National and International", published by the World Power Conference. In Great Britain, the British Standards Institution is the national standardizing organization and is responsible for the determination of British standard specifications. Though the Institution has a strict rule that it does not initiate standardization but waits to be approached by a recognized outside authority such as a trade association, technical institution, or Government department, it has already issued more than 560 British Standard Specifications, exclusive of some 160 specifications for aircraft materials and components issued in co-operation with the Air Ministry.

INTERNATIONAL standardizing organizations, such as the International Federation of the National Standardizing Associations (ISA) or the International Electrotechnical Commission (IEC) have also been established. ISA, for example, federates the national standardizing organizations of nineteen countries and was founded in New York in 1926 with the object of promoting co-operation, co-ordination and interchange of information. But international co-operation, in contrast to the development of standardization along national lines, has made slow progress. It was indeed the need for further development in this direction that led the International Executive Council of the World Power Conference to initiate this inquiry, and the report has been published with the hope that it may serve as a stimulus to a greater degree of co-operation in national standardization and to a closer co-ordination of the activities of international organizations engaged in standardization, to the end that duplication and overlapping may be avoided and international standardization may be more speedily effected.

Scientific Basis of Birth Control

IN *Science and Society* of June–September 1937 there appears an article on "The Scientific Basis of Birth Control" by Dr. C. V. Drysdale, president of the Malthusian League. The author remarks that the true, present-day application of the Malthusian doctrine may best be understood by reference to the affairs of an ordinary married couple. "The average young man marries when his income is sufficient to support a wife and perhaps one child, and, if that income were fixed, every additional child would mean a lowering of the family standard of existence." But, in many occupations, salaries rise with age and service, and if additional children come when there has been a sufficient rise in income, no lowering of the standard need take place. "This is the population problem as it confronts almost every middle-class couple." If children arrive at a greater rate than can be allowed for by increases of salary, then such a family is "over-populated". It amounts to this, that, in general, in civilized countries, birth-control has assisted in the preservation of the amenities and standards of living. Another aspect of birth-control is, of course, its application to what is called negative eugenics, that is, the avoidance of parenthood by persons afflicted with transmissible disease or defect. Dr. Drysdale looks forward to a future in which a planned social economy shall ensure general early marriage with reasonable family limitation. But it will be necessary to arrange that the limitation does not go too far, and the question is: How?

Fauna of the U.S.S.R.

SOME years before the Great War, the Russian Academy of Sciences launched an ambitious scheme of publishing detailed monographs on all groups of animals occurring within the Russian Empire and in neighbouring countries, under the title "Faune de la Russie et de pays limitrophes". The programme of the publication was so extensive that the first few volumes which appeared were sufficient to show the virtual impossibility of continuing the work on the same scale. The idea, however, was not abandoned, and the Academy of Sciences of the U.S.S.R. has now commenced the publication of a new "Faune de l'URSS", which aims at giving a full, but concisely written, monographic treatment mainly of the systematics and distribution of all animals already found, or expected to occur, in the Soviet territories. Six volumes and two smaller parts, mostly dealing with insects, have already appeared, and they make a very good impression, particularly as regards the generally high scientific standard, although the paper, printing and illustrations might be improved. Unfortunately, not all the volumes are by outstanding experts in the systematics of the groups treated, and some have apparently been prepared by authors who may be excellent specialists, but not in the groups they had to monograph. All foreign zoologists will be pleased to see that each volume has a very full summary in a Western language, in which all determination keys, new descriptions and more important notes are given. Since the "Fauna" covers the whole of extra-tropical Asia and eastern Europe, its value for systematists working on the palæarctic region will be inestimable, and volumes on their respective groups will be eagerly awaited by all zoologists.

The Botanical Society of Edinburgh

THE *Transactions and Proceedings of the Botanical Society of Edinburgh*, **32**, Part 1, 1936, is a particularly interesting number, including as it does the record of the centenary meeting of this Society. The main contribution is in effect a local flora—a list of the flowering plants and ferns from Fife and Kinross by William Young. The address delivered by Prof. F. O. Bower at the centenary meeting is included. No more appropriate speaker could have been found for that interesting occasion, and his appreciation of botanical progress during the period of activity of the Society could only have been delivered by a veteran whose reminiscences still feed his botanical enthusiasm. Prof. Bower points out how plant physiology has gained since 1836 by the precision that can now be assigned to the medium in which vital functions are proceeding, through the advances in cytology and anatomy. With arresting phrase and breadth of vision, in a few pages the main movements of botanical thought during the century are brought before the reader. The last half century, it is pointed out, because it is an age of specialization, has increased the need for the services of such general societies as the Botanical Society of Edinburgh. Prof. Bower indicates how the 'herd sense' among his fellow botanists is probably responsible for the temporary ascendancy of one field of investigation, thus leading to "multiplying instances of what has been already demonstrated". He then shows himself fully aware where the 'herd' is gathering now when he ends an eloquent plea for a modern morphology, based upon developmental studies of the meristem, with the speculation that hormones may then prove the key to unlock those phenomena of symmetry that are expressed in appendages. The Botanical Society of Edinburgh began principally as a means to the formation of a herbarium for its members, and has taken a prominent part in the creation of the magnificent herbarium that is now housed at the Royal Botanic Gardens.

Giorgi's System of Units

DR. A. E. KENNELLY recently presented a report, from the historical point of view, to the Society for the Promotion of Engineering Education, in regard to the adoption of the M.K.S. (metre-kilogram-second) system of units ("The M.K.S. System of Giorgi as adopted by the International Electrotechnical Commission (I.E.C.) in June 1935"). Dr. Kennelly has done his work well, giving a fair statement of the present position. Unfortunately, physicists and engineers are not yet agreed as to the best system of units to adopt. Many of them are in favour of following Heaviside and completely rationalizing the system of units. Others are more conservative, and think that the change, although saving much arithmetic, would scarcely be worth the labour involved in learning all the relations connecting the new and the old units. The two leading organizations are in agreement that a fourth unit is theoretically necessary to link internationally adopted electrical units with the dynamical units of the M.K.S. system. They agree that this fourth unit may preferably be 'space permeability' taken at the definite numerical value of 10^{-7} (unrationalized). This report of Dr. Kennelly's can do nothing but good.

Prohibition and Cirrhosis of the Liver

AT an address given at the recent annual meeting of the Royal Institute of Public Health at Margate, Dr. C. C. Weeks stated that, in the United States, when prohibition really was prohibiting, there was a marked decrease in the death-rate from cirrhosis of the liver and a rise as 'boot-legging' became more extensive. The liquor sold under 'boot-legging' conditions was much more alcoholic than usual, ethyl alcohol being so high as 70 per cent in much of the whisky sold. There was consequently a good deal of acute alcoholism attributed to all sorts of causes, whereas the one effective cause was that the whisky was 50 per cent stronger than usual. Since the repeal of prohibition, there has been a slight but steady increase in deaths due to alcoholism. Official figures for 1935 showed that, out of 24 States, 20 had an increase in the death-rate from cirrhosis, while only 11 showed an increase in the death-rate for alcoholism as compared with 1932. The steady drinking of a more normal alcoholic beverage was leading inevitably to more cirrhosis of the liver but to less acute alcoholism.

Society of Chemical Industry: Food Group

AT a recent meeting of the Food Group of the Society of Chemical Industry, it was decided, in view of the growing interest in food science and the diversity of the subject, to form panels within the Group. These panels will be responsible for directing the activities of the Group in connexion with their respective divisions of the science. The first two panels, of which there will be several, are now in process of formation, namely, a nutritional panel and a microbiological panel.

Studentships and Fellowships for Medical Research

THE Medical Research Council invites applications for a second series of studentships and fellowships for research into disease together with experimental work of an immediately relevant kind. Six post-graduate studentships are offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive an inclusive grant at the rate of £200 per annum, during a period not exceeding twelve months, for personal maintenance while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. Four research fellowships are also offered for candidates of similar qualifications who have already had some experience in the use of research methods. Each fellowship will be tenable for one year at the ordinary value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year. These fellowships are intended as probationary appointments for research in clinical science or experimental pathology. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1.

Announcements

SIR WILLIAM BRAGG, president of the Royal Society and director of the Royal Institution, has been elected an honorary associate of the Royal Institute of British Architects.

BY an order of the Committee of Privy Council, Mr. W. M. Goodenough has been appointed a member of the Medical Research Council on the retirement of the Right Hon. Lord Mildmay of Flete. Mr. Goodenough also succeeds Lord Mildmay as treasurer of the Council.

THE Howard Prize for 1937 of the Royal Meteorological Society has been awarded to Cadet Ralph Wills of H.M.S. *Conway* School Ship. Cadet Julius Cornel Donner and Cadet John Easton Neils Carter of H.M.S. *Worcester*, were placed second and third respectively. The subject of the essays was "The Meteorology of the Voyages of Discovery to America and to South Africa".

ON the occasion of the seventy-fifth birthday of Prof. E. Leclainche and of his election to the presidency of the Paris Academy of Sciences, the National French Syndicate of Veterinarians recently organized a ceremony in his honour. Prof. Leclainche is honorary director of the French Veterinarian Services and president of the International Office of Epizootics.

PROF. KARL NEUBERG, founder and editor of the *Biochemische Zeitschrift* and formerly director of the Biochemical Institute of the Kaiser-Wilhelm Gesellschaft, celebrates his sixtieth birthday on July 29. An issue of the periodical *Enzymologia*, with which he is associated, is to be published in honour of this anniversary; more than seventy authors, chiefly his pupils, have contributed to the number.

IT is announced by the New York correspondent of *The Times* that a fund of about £2,000,000 for cancer research has been given to Yale University by Mr. Starling W. Childs. It is to be called the Jane Coffin Childs Memorial Fund for Scientific Research, and the deed of gift provides that, if the problem of cancer should be solved, the Foundation is to devote itself to other unsolved medical problems or to problems in other fields of science.

A GENERAL Discussion on reaction kinetics has been arranged by the Faraday Society, to be held in the Chemistry Theatre of the University of Manchester on September 13–15. As is usual at these discussions, a number of distinguished foreign investigators have agreed to take part. Further particulars can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

READERS interested in psychology may like to know that a Graphological Society has been formed and the first public meeting will take place in October. The honorary secretary is Mrs. Paula Friedenhain, 50 Heathway Court, West Heath Road, London, N.W.3.

THE second Congress of the Austrian Society of Röntgenology will be held in the Central Röntgen Institute of the General Hospital at Vienna on July 10–11. Further information can be obtained from the Secretariat, Zentral Röntgen Institut, Allgemeines Krankenhaus, Alserstrasse 4, Wien IX.

AN institute for anatomy, physiology and hygiene is shortly to be opened at Riga.

DR. THEODOR VAHLEN, professor of applied mathematics at Berlin, has been made an honorary professor in the University of Greifswald.

THE fourth International Leprosy Congress will be held at Cairo on March 21, 1938. Further information can be obtained from the Secretary, 131 Baker Street, W.1.

THE Congress of the International Union of Towns will be held in Paris on July 5–10, when a discussion will be held on the campaign against smoke in various countries, and other subjects. Further information can be obtained from M. R. Hummery, 28 rue de Liège, Paris.

WE have received List No. 25, a catalogue of old medical books, issued by Messrs. E. P. Goldschmidt and Co., Ltd., 45 Old Bond Street, London, W.1. Among 214 items, are several early works on bacteriology and parasitology of Behring, Ehrlich, Koch and Laveran, and a collection of French X-ray photographic prints, made about 1896. It also includes a copy of the rare third edition of Harvey's "De Motu Cordis", a first edition of Laennec's "De l'Auscultation mediate", and early works on anæsthesia, ophthalmology, pharmacology and physiology.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 31.

Correspondents are invited to attach similar summaries to their communications.

Use of the Name 'Racemic Acid'

The discovery of racemic acid by Karl Kestner or Koestner, a chemical manufacturer at Thann, in the Vosges, and the elucidation of its relationship to ordinary tartaric acid, more especially by Gay-Lussac, Berzelius and Pasteur, constitute one of the most important episodes in the history of organic chemistry. Upon an account of the nature of racemic acid there is no need, and we do not intend, to enter here; but, owing to the confusion which exists in chemical literature regarding the authorship of the name *racemic acid* (variously attributed to Gay-Lussac, Gmelin and Berzelius), a note on this subject may be of interest to students of the history of chemistry.

The author of the term *racemic acid* is Gay-Lussac. The first occurrence of the term in print is found in a publication, "Cours de Chimie par M. Gay-Lussac, comprenant l'histoire des sels, la chimie végétale et animale", published in Paris by Pichon et Didier, in 1828. In the "Summary" at the beginning of the 24th Lecture, one finds the term, "Acide racénique", and on p. 23 one reads: "Ce serait ici le lieu de parler de l'acide raconique". The mis-spelling which is found here, *racenique* (with or without the accent) in place of *racémique*, finds its explanation in the fact that the "Cours de Chimie" was reproduced from shorthand notes of the course of lectures "professé à la Faculté des Sciences" by Gay-Lussac, and published without the co-operation or sanction of the lecturer. Gay-Lussac, in fact, protested vigorously against this *nouveau genre d'industrie*, which had arisen in Paris, of publishing the lectures of certain professors without their permission or supervision. "Je ne sais", wrote Gay-Lussac[1], "jusqu'à quel point il est juste de s'approprier ainsi des leçons publiques, contre la volonté même des professeurs; . . . Mais il n'est pas indifférent que l'on sache que je n'ai pris aucune part à cette nouvelle spéculation de librairie . . . Je déclare donc que mes leçons de chimie sont imprimées contre mon gré; que j'ai refusé les émoluments qu'on m'a offerts pour me faire coopérer à leur publication, et que je n'y prends absolument aucune part."

Meanwhile, the publishers had issued a note that "le désir que nous avions de terminer la publication de cet ouvrage presque aussitôt que le Cours du Professeur; la promptitude avec laquelle il a fallu par conséquent corriger les épreuves; et d'ailleurs la nécessité où nous fûmes de recourir à une autre personne que le Professeur, pour faire cette correction à laquelle il ne voulait pas se livrer lui-même, ont été cause que plusieurs fautes d'impression se sont glissées dans quelques-unes des Livraisons que nous avons adressées à nos Souscripteurs". The text was read by M. Gaultier de Claubry and a list of errata was drawn up. In this list, *racenique* is corrected to *racemique* (without an accent on the e). The unaltered text, however, was republished, with its errors, in 1833 by the firm of de Just Rouvier et E. Le Bouvier, Paris.

The authorship of the term, *acide racémique*, is established also by a footnote which appears in the French translation[2] of Berzelius's original Swedish paper. The French translation is entitled: "Composition de l'acide tartrique et de l'acide racémique (traubensäure), etc", and the footnote to this reads: "M. Gay-Lussac a donné, en 1828, le nom *d'acide racémique* à l'acide dont il est ici question." Thomas Thomson, who made an examination of racemic acid[3], also states in his "Chemistry of Organic Bodies. Vegetables" (1838), p. 66: "This acid has been described in the Chemistry of Inorganic Bodies (Vol. ii, p. 69) under the name of *vinic acid*. But the term *racemic acid*, given it by M. Gay-Lussac in 1828, is better."

While the authorship of the specific term *acide racémique*, applied to the isomer of tartaric acid which Berzelius, in 1830, proposed to call *paratartaric acid*[4], must undoubtedly be attributed to Gay-Lussac, the general application of the term racemic to the optically inactive, resolvable isomer of a substance, must be credited to Pasteur[5].

With regard to the position of Gmelin and Berzelius in the naming of the acid called racemic by Gay-Lussac, the facts are as follows. Walchner, in 1827, had carried out an investigation of racemic acid and its salts[6], and his results were communicated in Gmelin's "Handbuch der theoretischen Chemie", 3rd Edit., vol. 2, p. 53 (published in 1829). Here the acid is called, for the first time, *Traubensäure*; and in his paper communicated to the Swedish Academy of Sciences, Berzelius (p. 64) states: "Gmelin har gifvit den nammet drufsyra, Traubensäure". In this same paper, Berzelius suggested the name paratartaric acid, and this name was widely used. To sum up. To the acid discovered by Kestner and first called by John, "Säure aus den Voghesen", Gay-Lussac, in 1828, gave the name, *acide racémique*. In 1829, Gmelin called it *Traubensäure* (rendered by Berzelius in Swedish as *drufsyra*), and, in 1830, Berzelius called the acid, *acidum paratartaricum*.

Alex. Findlay.

Chemistry Department,
University, Aberdeen.
June 2.

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[1] *Ann. Chim.*, 37, 441 (1828).

[2] *Ann. Chim.*, 46, 113 (1831).

[3] *Records of General Science*, ii., 97, 161, 241 (1835).

[4] *Kongl. Vetensk. Acad. Handl.*, 49 (1830).

[5] *Ann. Chim.*, 61, 488 (1861).

[6] *Schweigger's J.*, 49, 238 (1827).

Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts

ACCURATE observations on cosmic ray intensities as measured by Neher electroscopes have been made in the equatorial belt (Madras, India, mag. lat. 3° N.) and in San Antonio, Texas (mag. lat. 38·5° N.) up to between 98 and 99 per cent of the way to the top of the atmosphere. The most significant results of these measurements may be summarized as follows:

(1) Cosmic rays, whatever their nature, are so rapidly absorbed as a whole in the outer layers of the atmosphere that even in the equatorial belt, where the effect of the earth's magnetic field upon them is a maximum, they get into equilibrium with their secondaries and produce their maximum ionization before they have penetrated through the first tenth of the atmosphere. (This effect was suggested as a possibility by Millikan and Cameron in 1927[1] in their report made at the Leeds meeting of the British Association on their first voyage (1926) made from Los Angeles to Peru to look for the effect of the earth's magnetic field on incoming electrons. The words then used were: "If the northern hemisphere and the southern hemisphere curves [of ionization with altitude] coincided, it would go a long way toward eliminating the possibility that the rays are generated by the incidence of high-speed beta rays on the very outer layers of the atmosphere. . . . For such beta rays would be expected to be influenced by the earth's magnetic field so as to generate stronger radiation over the poles than over the equator". This is precisely what the present experiments show to be the case for the whole field-sensitive portion of the cosmic rays.)

(2) From that point on, they fall off exceedingly rapidly in intensity, following an exponential equation, their law of absorption being like that of X-rays and not like that of particles that exhibit range phenomena such as low-energy beta rays, proton rays or alpha rays.

(3) The depth beneath the top of the atmosphere at which the maximum ionization is attained, always less than a tenth of an atmosphere, changes but slightly in going from San Antonio, where no electrons of energy less than 6×10^9 electron volts can get vertically through the blocking effect of the earth's magnetic field, to Madras where no electron-rays of energy less than 17×10^9 electron-volts can similarly get through.

(4) The difference between the San Antonio and the Madras curves makes possible for the first time the determination of the complete curve of ionization produced in the atmosphere by incoming charged particles contained within a sharply limited band of energies having a weighted mean value of 10×10^9 electron-volts.

(5) Down to a depth of a third of an atmosphere from the top (3 metres of water) this curve is in good agreement with the Bethe-Heitler theory of nuclear electron absorption as recently extended by Carlson and Oppenheimer as well as by Bhabha and Heitler.

(6) The exceedingly rapid absorption of this latitude-sensitive radiation, with an absorption coefficient which is nearly constant and independent of incident energy, qualitatively justifies the 'shower theory' of Millikan and Cameron as the main cause of the ionization of the atmosphere produced by incoming electrons even of this huge energy.

(7) The latitude-sensitive part of the cosmic ray ionization found in the *lower* part of the atmosphere is considerably more penetrating than is predicted by the foregoing extended Bethe-Heitler theory of electron absorption; nevertheless, while at a distance of one twentieth of an atmosphere from the top, these 10×10^9 electron volt field-sensitive rays are producing 160 ions per c.c. per sec., *at sea-level* their *total ionizing influence has fallen to but 0·3 ion per c.c. per sec.*, that is to less than 1/500 of its value near the top of the atmosphere.

(8) The two foregoing results in (7) show that the process of nuclear absorption of electrons is more complicated and involves the production of more penetrating secondaries than is pictured in the simple physical assumptions underlying the Bethe-Heitler theory, but, at the same time, that the whole progeny of secondaries, whatever their nature, has been reduced almost to zero by the time sea-level has been reached, not more than about one tenth of the sea-level ionization being accounted for by field-sensitive rays at all.

(9) The latitude-sensitive part of the cosmic ray ionization found in the lower atmosphere is practically all due to the *secondary* effects of varied nature resulting from the absorption of the incoming electrons in the upper tenth of the atmosphere.

(10) The *apparent* absorption coefficient, namely, 0·54 per metre of water, of the actual curve representing the whole progeny of secondary influences resulting down to sea-level from the absorption of incoming electrons in the very top layers of the atmosphere is approximately the same as that found by Johnson and by Neher for the east-west effect, thus proving that the particles causing the latitude and the east-west effect are of the same type. Both absorption coefficients are such as to suggest that these particles are electrons (predominantly positive), not protons.

I. S. BOWEN.
R. A. MILLIKAN.
H. V. NEHER.

California Institute of
Technology,
Pasadena, California.
June 15.

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[1] NATURE, 121, 20, 1937.

Longitude Effect and the Asymmetry of Cosmic Radiation.

IN a recent letter, Dr. M. S. Vallarta[1] has emphasized the discrepancy which arises from the comparison of the variation of intensity of the cosmic rays along the magnetic equator (longitude effect) and the position of the magnetic centre of the earth as determined from magnetic observations. According to Hoerlin, the longitude of the magnetic centre as determined by cosmic rays should be 100° E. instead of 160° E. as found directly.

The theory according to which the cosmic ray observations are interpreted is that the angle of opening of the cone $\pi/2 + \theta$ must be computed by Störmer's formula

$$\sin\theta = \frac{2}{r} - \frac{1}{r^2},$$

with a value of $r = r_0(1 - \rho\cos L + \ldots)$ proportional to the distance to the magnetic centre and therefore dependent on the eccentricity ρ of the dipole and on the difference of longitude L reckoned from the dipole (positive towards the east).

It should be noted that the angle θ in Störmer's formula is reckoned, not from the vertical of the place but from the line joining the dipole to the point of observation. If we take account of this circumstance, we find that the change of the angle of opening becomes

$$\Delta\theta = -\alpha\rho\cos L + \rho\sin L\,;$$

where the first term is the effect due to the change of distance from the dipole and the last term is the new parallactic effect. The coefficient

$$\alpha = \frac{2}{r_0}\left(\frac{1}{r_0} - 1\right)/\cos\theta$$

varies with the energy of the rays. For the rays just able to come from the zenith ($\theta = 0$), it is equal to 4 and its minimum value is $\sqrt{2}$.

For negative particles, the angle of opening of the cone must be taken not from the west but from the east, and therefore the sign of the new term must be inverted. The usual theory is therefore correct only if the rays are a mixture of positive and negative rays in equal amount. This is not the case, as the asymmetry measurements have shown that the positive rays are more important.

If we write $\tan\beta = 1/\alpha$ we get

$$\Delta\theta = \frac{-\rho}{\sin\beta}\cos(L + \beta),$$

showing that the improvement of the theory essentially amounts to reckoning the longitudes from an origin at an angle β west of the position of the dipole. This angle β, which is 0 for rays just able to reach the equator, is 14° for rays of 0·5 Störmer, that is, 15×10^9 eV. (for protons) and goes up to 35° for the limiting case of 60×10^9 eV. Although this correction is far from the 60° asked for by Hoerlin, it is in the right direction and will substantially reduce the discrepancy between theory and observation.

The fact that the longitude effect is different according to the effective value of the intensity of the rays and therefore according to the screens used, and also depends on the sign of the charge, will make the analysis more difficult; but when it is achieved, due to improvement in observations and also to progress in the working out of the details of the theory, it will probably afford information on the sign of the charge and the distribution of the intensity of the rays.

G. LEMAÎTRE.

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May 22.

[1] NATURE, 139, 94 (1937).

Crystallization of Lysozyme

THE occurrence in nasal mucosa of a substance capable of lysing certain bacteria was noted by Fleming[1], and this or a similar compound was later obtained from egg-white by Wolff[2] who, however, did not recognize the true chemical nature of the substance. Meyer, Thompson, Palmer and Khorazo[3], adopting an entirely different procedure, showed that lysozyme is a protein giving some of the typical reactions; they also quoted analytical data.

Dr. E. A. H. Roberts, of the Department of Pathology, has further improved the technique of the preparation and his results will shortly be published in another place. In the meantime we have undertaken the purely chemical side of the investigation of this interesting protein, and we wish to express our gratitude to Dr. Roberts and Prof. Florey for the facilities provided.

The material made according to the method of Roberts seems to possess a high degree of homogeneity and it may be crystallized by one operation from solution in $N/20$ acetic acid and concentration over aqueous potassium hydroxide in a vacuum desiccator. The crystals (Fig. 1, photomicrograph by Mr. H. M. Powell) appear to be dodecahedra, and Miss D. Crowfoot has kindly undertaken their crystallographic examination.

Crystalline lysozyme is about as active as the Roberts specimen in bringing about lysis of *Micrococcus lysodeikticus*, but comparisons by the method used are not capable of great accuracy.

Fig. 1.

Mr. H. S. Philpot has kindly studied the behaviour of lysozyme in the ultracentrifuge, and the molecular weight appears to be of the order of 18,000, a quite provisional estimate.

The ultra-violet absorption shows the usual tyrosine-tryptophan band at about 2770 A. in acid solution; this is shifted to about 2870 A. in $N/10$ sodium hydroxide solution. Using the method of Holiday[4], analysis of the curves indicates the presence of 4·4 per cent of tyrosine residues and of 2·2 per cent of tryptophan residues in the molecule.

E. P. ABRAHAM.
R. ROBINSON.

Dyson Perrins Laboratory,
University, Oxford.

[1] Fleming, A., *Proc. Roy. Soc.*, B, **93**, 306 (1922).

[2] Wolff, L. K., *Z. Immunitätsforsch.*, **50**, 88; **54**, 188 (1927).

[3] Meyer, K., Thompson, R., Palmer, J. W., and Khorazo, D., *J. Biol. Chem.*, **113**, 303 (1936).

[4] Holiday, E. R., *Biochem. J.*, **30**, 1795 (1936).

Thermal Decomposition of Ethylene Bromide

WHILE we were investigating the behaviour of certain gaseous alkyl and alkylene bromides at high temperatures, with the view of finding out how the energy of activation was related to the zero point energies (or vibration frequencies) of adjacent bonds (for example, tert.-butyl bromide with three C–C bonds might be expected to require a less activation energy than normal butyl bromide with two C–H and one C–C bonds) we found that the homogeneous nature of the decomposition could not always be predicted, and that the calculations made for ethylene bromide ($C_2H_4Br_2$) by Sherman and Sun[1] based on the Eyring method were somewhat misleading.

We used an all-glass pyrex apparatus, with a diaphragm gauge (electrical contact) balanced against a mercury manometer. The decomposition of ethylene bromide took place in a pyrex vessel immersed in a molten metal bath. The temperatures ranged from 340° to 400° C. and were controlled by a chromel-alumel thermocouple and potentiometer system. At 340°–370° the decomposition is heterogeneous; the introduction of pyrex glass tubing leads to considerable increases in the reaction velocity. The final pressure is double the initial pressure, the products of decomposition are vinyl bromide (C_2H_3Br) and hydrogen bromide, and the reverse reaction is not appreciable at these temperatures. The reaction follows the first order equation very well.

There is no decomposition into ethylene and bromine. The calculations of Sherman and Sun lead us to believe that the decomposition into ethylene and bromine would take place at an appreciable rate at 350° with an activation energy of 50,000 calories. We have calculated an approximate activation energy for the heterogeneous reaction of about 30,000 calories.

Since the ethylene bromide molecule prefers to dissociate into vinyl bromide and hydrogen bromide, we would be inclined to look for some structural explanation of this phenomenon. The *trans* form of ethylene bromide is considered to be the more 'stable' (preferred) form, even at high temperatures[2]. This interesting theory may explain how it is that ethylene bromide can become attached to the surface in such a way as to give rise to these decomposition products. It is very different from the behaviour of ethylene *iodide* ($C_2H_4I_2$), where an iodine atom (or an adsorbed iodine atom) acts as a catalyst for the decomposition into ethylene and iodine[3]. Also, the molecule decomposes homogeneously into the same products. Here one of the iodine atoms in the molecule acts as a sort of 'intramolecular catalyst'. One would expect the *cis* form of ethylene iodide to be its normal condition, but there do not appear to be any definite data on this point. Recently, however, the idea that ethylene iodide dissociates directly into ethylene and iodine has been disputed[4].

Further data and experimental details will be published shortly.

T. IREDALE.
A. MACCOLL.

Department of Chemistry,
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May 4.

[1] *J. Amer. Chem. Soc.*, **56**, 1096 (1934).

[2] Trumpy, *Z. Phys.*, **98**, 624 (1935).

[3] Arnold and Kistiakowsky, *J. Chem. Phys.*, **1**, 166 (1933); Iredale and Martin, *J. Phys. Chem.*, **38**, 365 (1934).

[4] Ogg, *J. Amer. Chem. Soc.*, **58**, 607 (1936).

Pyruvic Acid Dehydrogenation, Vitamin B_1 and Cocarboxylase

IT had been found by Davis[1] that pyruvic acid is oxidized by the acetone preparation of *Bacterium Delbrückii*. This preparation has proved to be very useful for a closer study of pyruvic acid dehydrogenation[2].

A codehydrase could be removed from the acetone-treated lactic acid bacteria by washing with phosphate of *p*H 8. The washed preparation was activated by the addition of decoctions of animal tissues (kidney, brain, liver). The addition of vitamin B_1 was without effect. Therefore cocarboxylase was tried, which had been found by Lohmann to be a vitamin B_1 pyrophosphate[3]. A pure preparation of cocarboxylase was most kindly supplied to me by Dr. K. Lohmann, with which the following experiment was carried out.

Activator	None	Kidney decoction	20γ cocarboxylase
Oxygen consumed in 30 minutes (c.mm.)	8	137	176

The effect of cocarboxylase is surprising, because no decarboxylation to aldehyde and carbon dioxide was found with the bacteria. Pyruvic acid was broken down only by dehydrogenation to acetic acid and carbon dioxide.

With highly concentrated organ extracts, the activation found was notably higher than with cocarboxylase at saturation. Probably the additional activation is due to the presence of flavin phosphate in the concentrates. A highly purified, but not pure, preparation of flavin phosphate from heart together with cocarboxylase gave the same additional activation.

Furthermore, it was found that no dehydration takes place with the complete system in the absence of free phosphate. Phosphate is easily removed from the acetone preparation by washing with an acetate mixture of *p*H 4·7. The effect of phosphate is shown by the following experiment.

Phosphate (10^{-3} *M*. per lit.)	0	1·4	2·8	5·5
Oxygen consumed in 60 minutes (c.mm.)	9	45	79	132

Phosphopyruvic acid was found to be inactive as hydrogen donator.

In the catatorulin test of Peters[4], free vitamin B_1 activates pyruvic acid oxidation with brain tissue. But from certain experiments, Peters *et al.* concluded that after the addition of vitamin, a substance *x* is converted into *y*, *y* being the activator of pyruvic acid oxidation. The experiments reported here suggest that the *x* of Peters is vitamin itself and the *y* vitamin pyrophosphate, into which it is converted by the tissue.

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Carlsberg Foundation,
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May 18.

[1] Davis, J. G., *Boichem. Z.*, **265**, 90 (1933).

[2] See also Lipmann, NATURE, **138**, 1097 (1936) and *Skand. Arch. f. Physiol.*, **76**, 186 (1937).

[3] Lohmann, K., *Naturwissenschaften*, **25**, 26 (1937).

[4] Peters, R. A., *Biochem. J.*, **30**, 2206 (1936).

[5] Peters, Rydin and Thompson, *Biochem. J.*, **29**, 53 (1935).

Crystals with Vitamin K Potency.

THE evidence for the existence of anti-hæmorrhagic vitamin (K) required by the chick for preservation of normal blood clotting time has been reviewed in a former paper[1].

This vitamin has been obtained in a crystalline fraction isolated from concentrates obtained in molecular distillation by cooling such concentrates in absolute methanol with solid carbon dioxide. The colourless crystal fraction obtained by this method was recrystallized from methanol three times by the same cooling procedure. Two such lots of crystals have been obtained.

The first lot was found capable of restoring normal blood clotting time within four days when added to the basal deficient diet given to five chicks with clotting time greater than 30 minutes. The second lot, tested by preventive assay, maintained normal blood clotting time in chicks when added to the basal diet, while the clotting time of chicks receiving no vitamin K supplement was in every case greater than 30 minutes.

Some vitamin still remained in solution. On the basis of comparative clotting times, the crystal fraction was approximately eight times as potent as the fraction not crystallized out by cooling with solid carbon dioxide.

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[1] Almquist, H. J. "The Anti-hemorrhagic Vitamin (Review)" *Poultry Science*, **16**, 166 (1937).

Effect of Hetero-auxin on the Growth of Broad Bean Plants in Water Culture

HITCHCOCK and Zimmerman[1] induced responses in the shoots of tomato and tobacco plants by applying a solution of hetero-auxin to the soil. These responses included bending, swelling, the production of adventitious roots on the stems, and epinasty of the leaves. This letter describes the relative effect of adding small amounts of hetero-auxin to the culture solution bathing the roots, and spraying approximately the same quantity on the shoots by the method described by Pearse[2]. *Vicia Faba* (Dobbie's Champion Long Pod) was used as the test plant, and the seedlings were three weeks old at the time of the first applications of hetero-auxin; the shoots were then about 10 cm. high. Fig. 1 shows the result of one week's treatment; the plants on the left were sprayed daily with 1 c.c. of a 0·01 per cent solution of hetero-auxin, those in the centre are the controls, while those on the right were supplied daily with 1 c.c. of a 0·01 per cent solution in 500 c.c. of culture solution.

Fig. 1.

THE SHOOTS OF THE PLANTS ON THE LEFT HAVE BEEN SPRAYED WITH HETERO-AUXIN, THOSE IN THE CENTRE ARE THE CONTROLS, WHILE THOSE ON THE RIGHT HAVE BEEN SUPPLIED WITH HETERO-AUXIN IN THE CULTURE SOLUTION TO THE ROOTS.

In Table 1 the average total length of lateral root for three plants, and the average dry weights of root and shoot are given.

Fig. 1 and Table 1 show that supplying hetero-auxin to the solution has retarded the growth in length of the roots, although the total root weight is practically unaltered, while spraying the shoots with hetero-auxin has slightly decreased the weight of root growth without altering its form. The shoot growth was retarded by both treatments, but whereas spraying induced swelling of the stem and epinasty of the leaves, the plants receiving hetero-auxin in the culture solution did not exhibit any such symptoms. The immediate effects of the treatments therefore appeared to be strictly local in each case, and the subsequent retardation of the growth of the parts of the plants other than those receiving the hetero-auxin would seem to be due to an alteration in the dynamic equilibrium of the plant, rather than to its movement within the plant body. The movement of hetero-auxin from the soil into the shoots of tomato plants noted by Hitchcock and Zimmerman[1] may have been due to the much greater amount of hetero-auxin applied.

TABLE 1.

Series	Total length of lateral root (cm.)	Root dry weight (mgm.)	Shoot dry weight (mgm.)
Control	385·4	356	917
Shoots sprayed daily with 1 c.c. of a 0·1 per cent solution of hetero-auxin	356·8	335	680
1 c.c. of a 0·1 per cent solution of hetero-auxin added daily to culture solution	180·6	352	642

The terminal bud was inhibited by spraying, an effect previously noted by Pearse[3] when spraying tomato plants with phenylacetic acid, and with indolebutyric acid. Thimann and Skoog[4] caused inhibition of the lateral buds of plants of *Vicia Faba* by applying hetero-auxin to the cut-off stump of the terminal bud; but here it has inhibited the growth of the terminal bud itself.

A full account of this work is being prepared for publication.

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May 11.

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[1] Hitchcock, A. E., and Zimmerman, P. W., *Contrib. Boyce Thompson Inst.*, **7**, 447 (1935).

[2] Pearse, H. L., NATURE, **138**, 363 (1936).

[3] Pearse, H. L., *J. Pom. and Hort. Sci.*, **14**, 365 (1937).

[4] Thimann, K. V., and Skoog, F., *Proc. Roy. Soc.*, B, **114**, 317 (1934).

Skatole as a Root Forming Substance

THE activity of skatole as a growth-promoting substance has been noted by Glover[1]. We have carried out experiments which show that skatole accelerates root formation in cuttings. Cuttings of *Leptospermum scoparium* and of *Ficus repens* were treated with an aqueous solution of skatole in the manner described by Hitchcock and Zimmerman[2], and the cuttings planted in a mixture of coco-nut fibre and sand in a propagator. The treatment accelerated root production. With *Leptospermum scoparium* cuttings, treatment for six hours with skatole solution of a concentration of 20 mgm. per 100 c.c. on March 19 gave 60 per cent of the cuttings well rooted in 20 days. A control set showed 30 per cent only of the cuttings to be slightly rooted. With

Ficus repens, a more marked response was obtained. Cuttings planted on April 22 and examined after 19 days showed in the control set 10 per cent rooted with an average of 0·3 roots per cutting and an average length of root per cutting of 1·6 mm. Of cuttings treated for 3 hours with a skatole solution of a concentration of 20 mgm. per 100 c.c., 90 per cent were rooted with an average of 4·2 roots per cutting and an average length of root per cutting of 38·4 mm.

Parallel experiments showed *l*-tryptophane to be inactive.

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June 1.

[1] NATURE, 137, 320 (1936).
[2] *Contrib. Boyce Thompson Inst.*, 8, 63 (1936).

Function of the Gills of the Mayfly Nymph, *Cloeon dipterum*

IT is generally supposed that the plate-like abdominal gills occurring in some ephemerid nymphs are respiratory organs, although little experimental evidence is available to support this view. Moreover, both Dewitz[1] and Cuénot[2] have shown that these gills are not essential to life. Recently, another function has been ascribed to these structures by Eastham[3], who shows that in the nymph of the mayfly, *Ecdyonurus venosus*, they act as paddles which bathe with water the gill tufts attached to their bases.

In order to test whether or not these gill plates are truly respiratory in nature, the oxygen consumption of both the normal and gill-less nymphs of the mayfly, *Cloeon dipterum*, has been measured at 10° C. at various oxygen concentrations. The results are shown in Fig. 1, each point in which is the average of three to eight experiments. This figure may be compared with Fig. 1 of Fox, Wingfield and Simmonds[4].

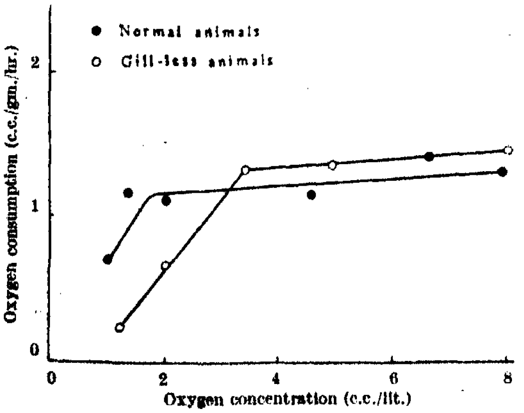

Fig. 1.

It will be seen that, as the oxygen content of the water is decreased, the oxygen consumption of both the normal and the gill-less nymphs remains nearly the same until a concentration of about 3 c.c./lit. is reached. Below this concentration the oxygen consumption of the gill-less nymphs falls off rapidly, but this marked decrease does not occur in the normal animals until the oxygen content of the water is reduced to about 1·5 c.c./lit. *It is clear that* the gills in this species of mayfly nymph only aid the oxygen consumption in water of low oxygen concentration, that is, below 3 c.c./lit.

At high oxygen concentrations, the gills of *Cloeon dipterum* only beat intermittently, but as the oxygen content of the water falls the quiescent periods are much reduced, thus causing a greater volume of water to pass over the dorsal surface of the animal in a given time.

It is not yet clear whether at low oxygen concentrations the level of oxygen consumption in the normal animal is maintained by gaseous exchange taking place at the gill surface, or whether under these conditions the gills merely act as paddles which pass a greater volume of water over the respiratory surfaces of the animal. Either of these processes would enable the animal to maintain its normal level of oxygen consumption at low oxygen concentrations.

The results summarized above will be published in full elsewhere.

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May 14.

[1] Dewitz, H., *Zool. Anz.*, 13, 525 (1890).
[2] Cuénot, L., "L'Adaptation", Paris (1925).
[3] Eastham, L., *J. Exp. Biol.*, 14, 219 (1937).
[4] Fox, H. Munro, Wingfield, C. A., and Simmonds, B. G., *J. Exp. Biol.*, 14, 210 (1936).

Zoological Nomenclature

IN spite of various criticisms, it must be admitted that the system of nomenclature used by zoologists and botanists is fundamentally sound and serviceable. Much depends, however, upon uniformity of practice, and certain irregularities which are becoming current are likely to cause serious confusion.

The International Code, Article 10, states: "When it is desired to cite the name of a subgenus, this name is to be placed in parenthesis between the generic and the specific names. Example: *Vanessa* (*Pyrameis*) *cardui*." The example is not well chosen, *Pyrameis* being a synonym of *Vanessa*; but the meaning is clear.

In the admirable *Review of Applied Entomology*, it has become the custom to cite an alternative generic name as if (according to the above rule) it were a subgenus. Thus, in the part for February 1937 we read "*Aonidiella* (*Chrysomphalus*) *aurantii*", for the red scale of the orange. *Chrysomphalus* is the older name, and opinions differ as to whether the red scale should be referred to that genus, with *Aonidiella* as a subgenus, or whether *Aonidiella* should be raised to full generic rank. The method of citation used by the Imperial Institute of Entomology, and indeed by others, would be intelligible were it not for the instructions given (following the usage of many decades) in article 10. If the method proposed in article 10 is abandoned, it is difficult to see how subgenera can be properly cited.

A quite different tendency, which seems to be on the increase, is to cite subgenera as if they were genera. An example (many more might be found) is furnished by C. Frick's "Horned Ruminants of North America", just published. A new subgenus *Stockoceros* is proposed for *Tetrameryx conklingi* of Stock; but although it is repeatedly stated to be a subgenus only, the species is written *Stockoceros conklingi*, or in one place *S.* (*Tetrameryx*) *conklingi*, and a subfamily Stockocerotinæ is proposed (p. 36) to include the group containing *Stockoceros*. Evidently the subfamily should be Capromerycinæ, based on the oldest genus, and in no case, according to the rules, can it be based on a subgenus. It might be possible to argue, perhaps, that in spite of his intention, Frick had in fact raised *Stockoceros* to generic rank by his mode of citation. Should this view prevail, Stockocerotinæ might be retained.

Another problem relates to the permissible length of generic and subgeneric names. Frick has, for example, a new subgenus *Pseudoparablastomeryx*. I have for many years followed a suggestion made by an author whose name I have forgotten, that such names should never exceed six syllables. There must be a limit somewhere, and perhaps the six-syllable rule would be acceptable, at least for future proposals.

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May 12.

The Number of Discriminable Colours

Although a calculation of the approximate number of discriminable colours must depend upon the individual concerned, 'normal' persons may be expected to furnish data which agree to the correct order of magnitude. The method used here involves the choice of an arbitrary colour solid, the well-known Titchener-Ebbinghaus double pyramid, to which available experimental data are applied with simplifying assumptions, in order that ordinary geometry may be used in the calculations. A straight line connecting the apexes of this double pyramid represents the *black-white*, or brilliance series; the *saturation* series is represented by lines running from the central axis to the surface; and the *hue* series is given by lines on the surface of the figure parallel to the base.

The observations of König[1], ranging from threshold to blinding intensity, give 660 discrete steps as the length of the brilliance axis. Jones[2], utilizing the measurements of Steindler, Nutting and himself, found 128 just noticeable chromaticity steps in the spectrum. Smith[3] obtained 28 hues in the psychological purples. For the total number of hues, equivalent to the perimeter of the base, we have 156. Data for saturation are taken from the incomplete experiments of Geissler[4], the work being done with coloured papers and covering only certain limited ranges. The results show 90 discrete steps from neutral grey to red. While Geissler did not determine the number of steps to each of the other corners, he measured the *relative* saturations from which the appropriate data may be computed: yellow, 35; green, 28; and blue, 67.

These values indicate that the base of the pyramid, if drawn to scale, could not be represented by conventional geometry. For the degree of approximation required here we may take arithmetical averages. We find 39 hue steps between each corner of the base and 55 saturation steps from the periphery to central grey. We shall assume that the number of hues, a function of the saturation, decreases linearly from periphery to centre, thus giving 78 hues at mean saturation. The number of colours in the base becomes 4,290. This is not the 'area', but the total colour sensations, the spacing of which depends upon location. Since König's results are approximately symmetrical, we may use the ordinary formula for the volume of a double pyramid, and thus we obtain for the number of discriminable colours, to two significant figures, the value $9 \cdot 4 \times 10^5$. If a double cone is chosen, the results will be the same.

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May 1.

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[1] König, A., *Z. für Psych. u. Physiol. der Sinnesorg.*, 8, 375 (1895).

[2] Jones, L. A., *J. Opt. Soc. Amer.*, 1, 63 (1917).

[3] Smith, F. O., *J. Exper. Psych.*, 8, 381 (1925).

[4] Geissler, L. R., *Amer. J. Psych.*, 24, 171 (1913).

An Effect of X-Radiation on the ζ Potential of Colloidal Graphite

In the course of our attempts to elucidate the nature of the action of X-rays on colloids, we have been investigating the effect of irradiation on the ζ potential of the colloidal particles. The sol selected for the preliminary experiments was an artificial graphite dispersed in conductivity water with the aid of traces of ammonia. This sol is practically homogeneous towards X-radiation, and has a low electrolytic content. It is stable, and the ζ potential of a given stock shows no significant changes over a period of four months. The ζ potential is deduced from measurements on the electrophoretic velocity of the particles. The experimental technique employed in our laboratory has been fully described by Lane and White[1], who have shown that the probable error of a single observation is of the order of 2½ per cent.

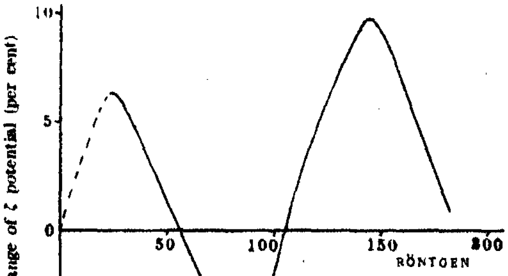

Fig. 1.

The nature of the results obtained is indicated, for small doses of radiation, in the accompanying graph (Fig. 1). The ordinates represent the percentage change in ζ potential, the abscissæ the corresponding doses measured in röntgens. It will be seen that a significant increase in the negative ζ potential is produced by a dose of only 25 r., but that the effect is not a monotonic function of the dose. The oscillations persist, with undiminished amplitude, but with increasing wave-length, up to doses of 25,000 r. Effects of a similar kind were also obtained with gamma radiation. For one of the sols measured the percentage changes in potential at the first maximum (25 r.), first minimum (85 r.) and second maximum (143 r.) were + (7·0 ± 0·6) per cent, − (6·0 ± 0·5) per cent and + (9·6 ± 1·1) per cent respectively. The scatter of the separate observations for a particular dose was, in all cases, consistent with the estimate of the probable error of a single observation given by Lane and White.

The demonstration of a significant physical effect in a stable colloid by X-radiation amounting to no more than 25 röntgens is, so far as we can ascertain, novel: as is also the peculiar relation between effect and dosage. The experiments, in which we have been aided by a grant from the British Empire Cancer Campaign, are being continued.

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June 1.

[1] *Phil. Mag.*, **23**, 824 (1937).

Determination of Electronic Charge by the Oil Drop Method

WE have eliminated the convection current and the effect of the arc and minimized the variation of time of descent of the drops and the greatest common divisor, by using our new oil.

The battery used was two ampere-hour lead cells, highly insulated, giving constant potential with drop of less than two volts per 10,000 volts per five hours. This high potential enabled us to reduce the number of charges on the drop considerably. The water of the bath was constantly circulated and its temperature controlled to within a few thousandths of a degree centrigrade for a period of weeks. The condenser plates, having a diameter of 22 cm. and thickness of 2·5 cm., were of stainless steel, optically polished and separated by the quartz prisms. The air used in the tank was dry and free from foreign matters. The timings were recorded on the Société Genevoise printing chronograph, which was controlled every second by the Riefler master clock of the Institute, the variation of which is less than one hundredth of a second per day.

With these precautions and improvements, and further, eliminating the non-spherical drops, we have determined the electronic charge, using Harrington's value for viscosity, and obtained

$$e = (4{\cdot}806 \pm 3) \times 10^{-10} \text{ E.S.U.}$$

We wish to express our thanks for a financial grant from the Hattori Hokokai.

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May 15.

Temperature Variation of Magnetic Anisotropy of Organic Crystals

As has been shown by Krishnan[1] and his collaborators, the study of the magnetic anisotropy of organic crystals enables us in many cases to determine the orientation of the molecules in the crystal lattice. A natural extension of this important line of work, suggested to me by Sir C. V. Raman, is the investigation of the effect of temperature on magnetic anisotropy, which may be expected to yield valuable information regarding the character of the thermal motions (for example, oscillations and hindered or free rotations) of the molecules in the crystal lattice and to elucidate the mechanism of fusion.

I have carried out measurements in the case of resorcinol over a range of temperature from 26° C. up to the melting point (110° C.) of the substance. Resorcinol was chosen because the crystal is stable and does not volatilize easily. The structure of the crystal has been studied by Robertson[2] by X-ray analysis, and the magnetic anisotropy at room temperature has also been determined by K. Lonsdale[3]. The method described by Krishnan[4] was adopted for the measurement of anisotropy, a modified technique being employed for fixing the crystal at the end of the quartz fibre and for making the measurements at the higher temperatures.

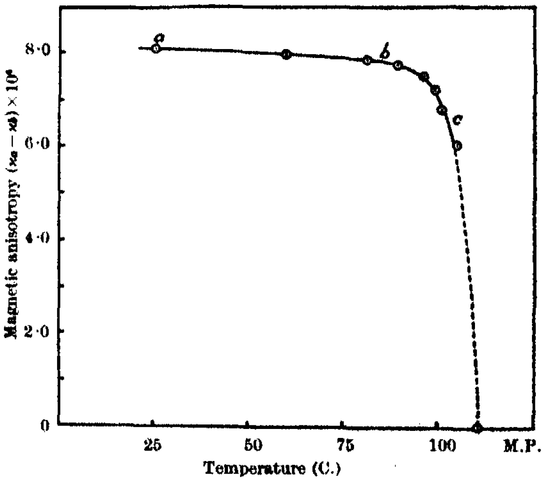

Fig. 1.

The following experimental procedure was adopted. For any setting of the crystal, the magnetic anisotropy in the plane concerned was first of all determined at room temperature. The crystal was then raised to the desired temperature by electrically heating the surrounding tube, the temperature at the region near the crystal being measured by means of a calibrated thermo-element. The magnetic anisotropy at the high temperature was then measured. The crystal was finally allowed to cool down to room temperature and the anisotropy again measured. It was found that when the high temperature did not exceed 105° C., the initial value of the anisotropy was almost fully restored. In all cases the mean of the initial and the final values of the magnetic anisotropy at room temperature was used in the calculations.

The variation of the magnetic anisotropy with temperature when the crystal is suspended with the *c* axis vertical is shown in Fig. 1. Up to about 15° C. below the melting point, the change of anisotropy is comparatively small. From *b* to *c* on the curve the variation is pronounced. From *c* onwards the transition is very rapid, indicating a state of instability. When the crystal was heated until it began to melt, the anisotropy practically disappeared. It is significant that the effect of temperature becomes prominent only in the vicinity of the melting point.

A determination of the magnetic anisotropy of resorcinol at room temperature gave the values: $\chi_a - \chi_b = 8{\cdot}13 \times 10^{-6}$, $\chi_c - \chi_b = 13{\cdot}30 \times 10^{-6}$, $\chi_c - \chi_a = 5{\cdot}22 \times 10^{-6}$, whence assuming Pascal's value

$-67\cdot2 \times 10^{-6}$, for the mean susceptibility, we get $\chi_a = -66\cdot2 \times 10^{-6}$, $\chi_b = -74\cdot3 \times 10^{-6}$, $\chi_c = -61\cdot0 \times 10^{-6}$, and $\alpha = 55\cdot9°$, $\beta = 47\cdot0°$, $\gamma = 62\cdot1°$, in satisfactory agreement with the results of K. Lonsdale.

I have also made a preliminary investigation of the magnetic anisotropy of ammonium nitrate at different temperatures up to the melting point of the crystal. The magnecrystallic data seem to lend support to the findings of X-ray analysis[5] in regard to the variation of the crystalline structure of ammonium nitrate with temperature.

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May 18.

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[1] Krishnan, K. S., Guha, B. C., and Banerjee, S., *Phil. Trans.*, A, **231**, 235 (1933).

[2] Robertson, J. M., *Proc. Roy. Soc.*, A, **157**, 79 (1936).

[3] Lonsdale, K., NATURE, **137**, 826 (1936).

[4] Krishnan, K. S., and Banerjee, S., *Phil Trans.*, A, **234**, 265 (1935).

[5] Hendricks, S. B., Posnjack, J., and Kracek, E. C., *J. Amer. Chem. Soc.*, **54**, 2766 (1932).

The X-Ray Microscope

As I pointed out some time ago[1], a new kind of X-ray spectra can be obtained by focusing the characteristic X-radiation emerging from the surface layer of an object. Instead of the usual spectral lines, these spectra contain a series of monochromatic *spectral images*, each of them showing the distribution of a certain chemical element in the surface layer of the object. Fig. 1 shows a new arrangement of the object, crystal and photographic plate giving a more distinct and even enlarged monochromatic X-ray image. The object O is excited to secondary radiation by primary X-rays. The secondary radiation is reflected on the concave side of the cylindrical crystal K and collected to the true monochromatic X-ray image I. If the dimensions of the object are small compared with the radius R of the crystal, it is possible to satisfy the conditions for a *true enlarged image* by adjusting the positions and inclinations of object and photographic plate.

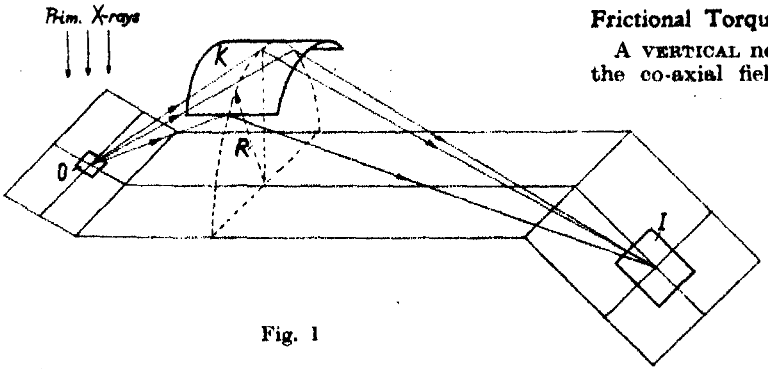

Fig. 1

The test-object for the method was a packet of thin metal foil polished perpendicular to the planes of the different layers. Fig. 2 shows the X-ray photomicrograph of such a test-object (above), with the dimensions of the different layers (below). The X-ray photo-micrograph corresponds to the iron K-α-radiation, and as this radiation consists of two slightly different wave-lengths, the image of the iron foil appears twice.

By such X-ray photomicrographs chemical analysis for a great number of chemical elements in objects not larger than 10^{-8} c.c. is made possible without dissipating the sample.

A more detailed theory of this X-ray microscope will be published in the *Journal of Scientific Instruments*.

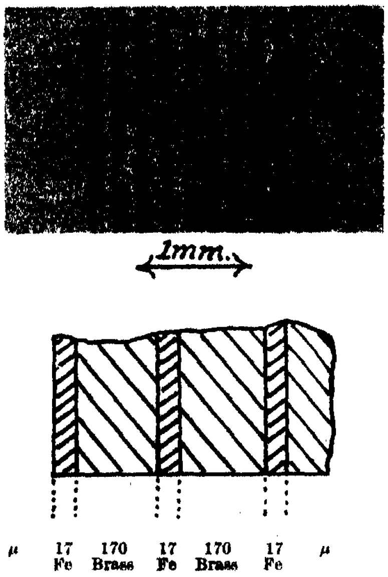

Fig. 2

I wish to acknowledge my grateful thanks to Prof. G. Aminoff for giving me the opportunity to carry out this investigation at the Mineralogical Department of the Riksmuseum, Stockholm, and to Prof. W. L. Bragg for suggestions concerning the publication of this paper.

L. v. HÁMOS.

Riksmuseum,
Stockholm, 50.
April 19.

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[1] NATURE, **134**, 181 (1934).

Frictional Torque of an Axial Magnetic Suspension

A VERTICAL needle of iron suspended *in vacuo* by the co-axial field of a solenoid theoretically may have infinitesimal frictional torque against axial rotation. The purpose of the present note is to report an observed value of this frictional torque.

The arrangement used is a modification of that previously reported by one of us[1]. A solenoid carrying a steady direct current produces a magnetic field sufficiently strong to support a large fraction of the weight of the needle. A vane mounted on the needle controls the amount of light striking a photo-cell. The current from this cell is amplified and fed to a second lifting solenoid. Thus the needle is automatically maintained at a pre-determined height. Vertical oscillations about this position were damped out by using a large resistance in, and capacitance across, the power supply for the amplifier output tube[2].

For this experiment the vane was a solid aluminum alloy disk, 15 mm. in diameter and 5 mm. thick, mounted co-axially with the needle. The entire unit had a mass and moment of inertia of about 6 gm. and 0·8 gm. cm.^{2} respectively. It was spun *in vacuo* by the action of the field of a small bar magnet mounted horizontally on an air-driven turbine[3] spinning below the disk at about 1,500 rev./sec.

The rotor was speeded up to about 1,200 rev./sec. Its action was such as to indicate that small or large rotors probably can be taken up to their bursting speeds with macroscopic stability, and that many types of drive may be used.

Damping observations were carried out at speeds in the neighbourhood of 600 rev./sec. with the driving magnet removed. Under these conditions, one encounters a frictional torque due to residual gases, and three torques of electromagnetic origin due to misalignment and the earth's magnetic field. In this preliminary work the residual gas pressure was estimated to be of the order of magnitude of 10^{-5} mm. mercury, alignment was done roughly, and no attempt was made to neutralize the earth's field. However, the observed deceleration at the above speed was about 2×10^{-3} rev./sec.^{2}, corresponding to a frictional torque of about 10^{-3} dyne cm.

It is believed that this device offers possibilities in experiments in which it is necessary to suspend rotatable systems under a variety of conditions. The low frictional torque exhibited suggests its use in experiments in which this property is useful directly, or indirectly as in the attainment of relatively constant rotational speeds for use in velocity of light determinations, etc.

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J. W. BEAMS.

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University of Virginia.
May 12.

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[1] Holmes, F. T., *Phys. Rev.*, **51**, 689 (1937).

[2] Reported by F. T. Holmes at meeting of the Va. Acad. Sci., May 7, 1937.

[3] Beams, J. W., Weed, A. J., and Pickels, E. G., *Science*, **78**, 338 (1933).

Points from Foregoing Letters

Measurements of cosmic ray intensities at various atmospheric heights at Madras, India and San Antonio, Texas, indicate, according to Prof. I. S. Bowen, Prof. R. A. Millikan and Dr. H. V. Neher, that the incident cosmic rays produce their maximum ionization before they penetrate more than one tenth of the atmosphere. The authors deduce, from the absorption coefficient down to sea-level, that the particles in the cosmic rays are predominately positive electrons, not protons.

Prof. G. Lemaître points out that the discrepancy in the position of the magnetic centre of the earth, as determined from magnetic measurements and as calculated (from the variations in the intensity of cosmic rays along the magnetic equator), is considerably reduced if one takes into consideration that the cosmic rays consist mainly of positively charged particles.

A photomicrograph of crystals of lysozyme, a protein occurring in the nasal mucosa, capable of lysing certain bacteria, is submitted by E. P. Abraham and Prof. R. Robinson. From the ultra-violet absorption spectrum, the presence of 4·4 per cent of tyrosine and 2·2 per cent of tryptophane is deduced.

Dr. T. Iredale and A. Maccoll find that ethylene bromide ($C_2H_4Br_2$) decomposes at 340°–370° in a pyrex vessel into vinyl bromide (C_2H_3Br) and hydrogen bromide. This reaction is heterogeneous. No decomposition into ethylene and bromine was observed. The authors suggest that the *trans* form of ethylene bromide is the more stable at high temperatures.

Addition of cocarboxylase to acetone-treated lactic acid bacteria (which had thereby lost the ability to dehydrogenate pyruvic acid) restores their power of dehydrogenation, or oxidation, according to F. Lipmann. The presence of phosphate is essential to the reaction.

H. J. Almquist reports that vitamin K, which preserves normal blood-clotting in chicks, has been obtained in crystalline form.

Dr. H. L. Pearse finds that hetero-auxin sprayed on to the shoots of plants of the broad bean grown in water culture causes swelling of the stem, epinasty of the leaves, and inhibition of the terminal bud, while the form of the root growth is unaffected. Approximately the same amount added to the culture solution retards the growth in length of the roots, and accelerates their growth in thickness, while the shoots, although slightly retarded, remain normal in appearance.

Experiments with cuttings of *Leptospermum scoparium* and of *Ficus repens*, confirming the root-stimulating properties of skatole, are reported by L. G. G. Warne and A. A. Jackson.

C. A. Wingfield has compared the oxygen consumption of normal and gill-less nymphs of a mayfly at various oxygen concentrations. It appears that the gills play little or no part in respiration at high oxygen concentrations, and only aid the oxygen consumption when the oxygen content of the water is reduced to a low value.

Using the Titchener-Ebbinghaus colour pyramid as the psychological colour solid, Dr. G. B. Welch calculates the number of discriminable colours to be of the order of 940,000.

A curve submitted by J. A. Crowther and H. Liebmann shows that when a colloidal dispersion of graphite is treated with increasing doses of X-rays, its zeta-potential (measured by the velocity of the suspended particles in an electric field) alternately increases and decreases.

A new determination of the charge of an electron by Y. Ishida, I. Fukushima and T. Suetsugu, with additional precautions and improvements, gives a value of $e = (4{\cdot}806 \pm 3) \times 10^{-10}$ E.S.U.

An X-ray microscope by means of which a true enlarged image of chemically different layers, about 1/100th millimetre apart, was obtained, is described by Dr. L. V. Hamos. It depends on the focusing of the characteristic secondary radiation emitted from a surface layer of an object subjected to primary X-ray irradiation.

Drs. F. T. Holmes and J. W. Beams describe a macroscopically stable axial magnetic suspension which has a very small frictional torque. A six gram rotor when coasting at 600 r.p.s. required about eight minutes to lose one revolution per second.

Research Items

Delaware Ceremonies and Dances

MR. FRANK G. SPECK, who has made a detailed study of the Big House ceremonial of the Delaware, or Lenape Nation, now turns his attention to other ceremonies of no less importance, but of lesser duration (*Mem. Amer. Phil. Soc.*, Philadelphia, **7**; 1937). The Big House ceremonial lasts for twelve consecutive nights, and is the periodical communal ceremony, which is the consummation of Delaware religious fervour. It expresses their attitude towards the benign Supreme Being. In their annual cycle, however, there is a number of other rites and ceremonies, in which they enter into relation with other spiritual beings, from whom, for the most part, evil is anticipated. Even though the Lenape have been removed from their original home in Pennsylvania and New Jersey to Oklahoma, these ancient rites have continued in practice down to the present day. It is probable that they are of a more ancient origin than the Big House ceremony. Some of them, as for example the Grease Drinking ceremony and the Doll dance, are family properties handed down as obligations to the tribe within the family group. The ceremonies are supposed to have originated through the mythical association of family ancestors with supernatural agencies. This is usually explained in a mythical narrative. Their purpose is to satisfy an offended spiritual force and to prevent a recurrence of the original misfortune avoided by the rite. The group performing the ceremony gains an added blessing in some form, such as an augmentation of crops. There are various officials of the ceremonial, of whom the chief is a master of ceremonies. The performance usually takes place at night. In addition to the description of the ceremonies, an account is given of the Delaware form of the dance taking place when the bones of the dead, from which the flesh has been stripped, are buried.

Early Peruvian Textiles

A LARGE number of specimens of textiles from early sites in the Nasca valley, Peru, numbering one hundred and sixty in all, collected by Prof. A. L. Kroeber in 1926, on behalf of the Field Museum, Chicago, have been described by Dr. Lila M. O'Neale, associate curator of textiles in the Museum of Anthropology at the University of California (*Anthropology: Memoirs*, Field Museum, Chicago, **2**, 3). In an introductory note, Prof. Kroeber points out that Early Nasca textiles were not previously well known, and in fact were scarcely recognized; but the present material affords adequate data for satisfactory study, owing to the fact that he was able to establish the archæological associations of his specimens. It has now been shown by Dr. Tello's archæological investigations at Paracas that the finely embroidered polychrome shawls and garments, at first identified as Ica and then as Nasca, are now to be associated with Paracas. The stylistic relation between Early Nasca pottery designs and those of Paracas textiles is so close as to leave little doubt of a common origin, the pottery probably being the earlier. The Early Nasca textile art discovered in association with Early Nacsa pottery is largely decorative and tends to the geometrical, while its representations of naturalistic impulses are relatively undeveloped. Nasca pottery and Paracas fabrics go together, while Nasca fabrics and Paracas pottery are alike in not attempting naturalistic representation. When the Early Nasca peoples wanted a picture on cloth, they painted it on. One example of this was found, duplicating in design a well-known Early Nasca pottery type, birds in attitude and placement in the design being identical with birds painted on double-spouted jars. The most striking feature of the Early Nasca textiles is their range of colours. They show a total of 190 hues by comparison with a colour scale, the majority to be described in terms of red, orange and yellow. The material used is a finely spun cotton yarn. Five of the eight standard weaves known to modern weaving were known to the Early Nascans, and in addition they did wrapped weaving, as in basketry.

Problems of Population Density

THE biological principles affecting populations are discussed by Raymond Pearl (*Amer. Naturalist*, **71**, 50), with references to experimental work on animal populations. He points out that the fundamental underlying principles are the same in man and in other animals; and that population growth or decrease has had an important effect in shaping political conduct and national policies, human populations differing in size, growth and quality. He is inclined to conclude that the human population of the earth grew very slowly until about three centuries ago, and then, as a result of scientific discoveries, took a great spurt and so increased from some 445 millions to more than 2,000 millions, or 40 persons per square mile of the earth's land surface. He regards this cycle of population growth as about two-thirds completed, and compares it with the cycles of lessening population. He interprets these cycles as beginning with a period in which the population remains relatively constant, followed by abatement of some of the natural checks, which leads to rapid increase. Population density finally reaches a point where new stimuli, reinforced by gregariousness, lead to migratory movements and ultimate destruction of masses of individuals. In the same journal, Dr. Thomas Park discusses in detail the recent experimental work on insect populations, with special reference to density effects.

Laboratory Diagnosis of Psittacosis

PSITTACOSIS or 'parrot' fever is a virus disease of cage birds, and is communicable to man, in whom it causes a serious and often fatal malady. This disease was comparatively prevalent in Great Britain and in the United States some years ago, and was of sufficient importance for the Ministry of Health to issue a memorandum, with recommendations upon its diagnosis and prevention. As a result of recent investigations, it has become possible to give more precise indications for the detection of the disease in man and in animals, and the Ministry of Health has published a report containing details of the technique of laboratory diagnosis (Laboratory Diagnosis of Psittacosis. Reps. on Pub. Health and Med. Subjects, No. 80. London: H.M. Stationery Office. 6*d*. net). The examination of suspected birds and of suspected human beings is described. The staining of smears of material for virus bodies, and the microscopic appearance of the virus are also described, and the appearances found are illustrated in an excellent coloured plate.

Feeding of *Chirocephalus*

SIR E. RAY LANKESTER in his essay on *Apus* (1881) first used the term 'gnathobase' for the proximal endite of the trunk limb, stating that it was a jaw-process which clearly had the function of assisting, by means of apposition to its fellows on the opposite side, in seizing and moving particles which may be introduced into the mouth. A. G. Lowndes, in his recent paper on *Chirocephalus* (The Term "Gnathobase" (Lankester). *Proc. Zool. Soc. Lond.*, B, Part 1 ; 1937), is in complete agreement with Lankester, and concludes from direct observations and by the use of his strobographic method, described in NATURE (**135**, 1006 ; 1935) that the setules of the basal endites can and do act in apposition while the limbs are working normally. He finds, however, that they do not do so always, and this, he believes, confirms his previous observation that the endites are under both muscular and nervous control and that one need not look upon the passage of food particles towards the mouth as being in any way automatic. Mr. Lowndes and his pupils have examined hundreds of specimens of *Chirocephalus* for gut contents, and find that the food consists almost entirely of quite coarse particles, such as remains of vascular bundles of leaves, etc., which are to be found at the bottom of most ponds. Other detritus such as algal filaments, leaves of moss, and dead Entomostraca are also found in the gut.

New Porcellanids and Pinnotherids

UNDER the title "Porcellanids and Pinnotherids from Tropical North American Waters", Mr. Steve A. Glassel describes several interesting forms, mostly collected by himself (*Trans. San Diego Soc. Nat. Hist.*, 8, No. 21 ; 1936) from the west coast of Mexico and from the Gulf of California. Four new species of *Petrolisthes*, three of *Pisosoma*, two of *Pachycheles* and three of *Porcellana* are included. The new genus *Orthochela* in the Porcellanidæ is created for another new species, *O. pumila*, which is very peculiar in the shape of its carapace, resembling *Uroptychus* in the family Galatheidæ. This crab is figured and also the outer maxillipedes of the three new species of Pinnotheridæ, *Fabia unguifalcula*, *Dissodactylus xantusi* and *Pinnixia richardsoni*. Otherwise the paper is not illustrated.

Locust Control

THE Committee on Locust Control of the Economic Advisory Council has issued a fifth survey of the locust outbreak in Africa and Western Asia. The latest of these surveys deals with the situation in 1935 and has been prepared by Dr. B. P. Uvarov, in collaboration with Miss W. Milnthorpe, of the Imperial Institute of Entomology. It appears that the outbreak of the three species of locusts, which have brought about so much damage during the past eleven years, is subsiding. At the same time it is pointed out that no relaxation in the campaign of locust investigation would be justified on this account. The desert locust, for the first time since 1926, had not invaded North Africa. The appearance of a swarm in May, 1926, in the Darfur province of the Anglo-Egyptian Sudan is disquieting, since its origin must be in an unexplored coastal area of the Red Sea. The possibility that it may sooner or later develop into a new invasion needs to be kept in mind. As regards the African migratory locust, it is now known that the outbreak centres are in the Middle Niger region. It is believed that this area is the only real danger spot in the whole continent of Africa in so far as this species is concerned. Practical measures are being planned for the permanent supervision of that outbreak area. With the red locust, heavy mortality has been caused by the fungal disease *Empusa grylli* among both the hoppers and winged forms. Viewed generally, the outbreak of this species is on the decline ; but swarms are likely to be still produced for some years to come.

Mutation in Tobacco Virus

MUTATIONS in viruses are the subject of a paper by Dr. H. H. McKinney (*J. Hered.*, **28**, No. 2), who cites experimental work, especially with mosaics of tobacco. While these viruses tend to remain true to type over long periods, yet they give rise in local zones of the infected plant to aberrant viruses which when isolated induce distinct symptoms. Some of these aberrant viruses in turn give rise to others. This is interpreted as a mutational phenomenon. Such mutants differ in the changes they produce in the chlorophyll mechanism of the leaf, some producing no disturbance, others a slight disturbance (light green mottling), others a yellowish-green, yellow or even almost white colour. Temperature has an important effect on these disturbances. Nearly a hundred mutants have been isolated from the common mosaic, but the number of distinct types is uncertain. Sub-mutants are also produced, the whole system of types tending to show certain relationships. The generation of these bodies is believed to be different from that of an enzyme from its precursor. The primary virus and its mutants are regarded as a series of closely related compounds which function essentially as genes.

A Rice Fermentation

ALCOHOLIC fermentations fall into three groups : (1) the direct inoculation of the fruit juice by yeasts as in wine production ; (2) the fermentation of a grain extract after pretreatment as the malted grain in beer ; and (3) the reinoculation of a partially cooked plant material. Rice as a source of alcohol has had to be approached from this third angle by K. Rami Reddi and Dr. V. Subrahmanyan, of the Indian Institute of Science, Bangalore, who have published a most interesting paper upon 'Sonti' fermentation (*Trans. Nat. Inst. Sci., India*, **1**, No. 11, 1937), which describes and analyses traditional methods of rice fermentation handed down from father to son, often as secret customs in small village communities, and then gives a preliminary estimate of their biochemical and biological basis. The 'Sonti' fermentation is practised in certain districts of the Madras Presidency. The main organism associated with the process appears to be a hitherto undescribed species of *Rhizopus* provisionally named *Rhizopus Sontii*. It is allied to *R. cambodia*, but its physiological activities are more pronounced. Indeed *R. Sontii* may have a practical future before it as it liquifies and saccharifies cooked rice more rapidly than other well-known organisms, including *Aspergillus oryzæ*. This paper is fascinating in its linkage of tradition with modern problems of biochemistry and mycology, and it shows the great possibilities of advance in standards of nutrition as the result of scientific study of methods of food preparations that are acceptable to a conservative native population. Studies of the species of *Rhizopus* isolated from Chinese yeast cakes such as are used in brewing alcohol from cereal grains in China, Manchoukou and Korea are also being extensively carried out by M. Yamazaki, professor of zymology (*Bull. Utsunomiya Agric. Coll.*, A, 2, No. 6, 1937).

Cyclones in the South Indian Ocean

MISCELLANEOUS PUBLICATIONS of the Royal Alfred Observatory, Mauritius, have in recent years included an annual publication in which an account is given of all the tropical cyclones that have been noted in the last cyclone season in the South Indian Ocean from Cocos Keeling Island across to Madagascar and the adjacent coast of South Africa. Publication No. 16, by N. R. McCurdy, director of the Observatory, which is the seventh of its kind, covers the season 1933–34. The number of depressions of sufficient intensity to be classed as tropical cyclones or hurricanes in that season was eight, which is about the average number; but the weather was more than usually disturbed during the hurricane season, and seven other disturbances are referred to briefly. It is said to have become increasingly evident in recent years with improvements in the synoptic charts, that the formation of cyclones is closely related to the periodic invasions into low latitudes of the cooler air associated with subtropical high-pressure systems. These systems usually move north-eastwards from South Africa but sometimes northwards. In the season under discussion, areas of disturbed weather always developed at the northern limit of the high-pressure wave when the latter was of appreciable intensity, and these sometimes led to the development of a tropical cyclone. Observations with pilot balloons at Mauritius showed that this happened whenever the east or south-east trade winds of the 'high' extended up to 5,000 metres. This is held to be a result of importance in forecasting, in the absence of enough observations from the Indian Ocean to the north of Mauritius to permit of the approach of cyclones to be studied for some days before their arrival near to or over the island itself. None of the storms of this season appears to have been of very outstanding intensity, but some showed interesting features; for example, that of January 26–February 2, which was deflected from its course by the high land of Mauritius, although the highest 'peak' of the island has only an elevation of about 2,700 ft. Another storm in March was broken up into two centres by its encounter with Madagascar, and soon died out.

Absolute Measurements of Sound Intensity

E. N. DA C. ANDRADE and R. C. Parker (*Proc. Roy. Soc.*, A, 159, 507) have measured the amplitude of vibration of smoke particles suspended in a vibrating air column. A theoretical calculation shows that, in the case of fine particles (radius about 0·03 μ), this amplitude is very nearly indeed that of the air itself, and this result is confirmed by the fact that particles of different size in the same air column show the same amplitude of motion. The particles were seen and photographed by scattered light: they appeared as well-defined short lines of light. The apparatus was kept at a constant temperature both to reduce convection and to give generally consistent operation. When the apparatus had been calibrated, it was used to determine the minimum amplitude audible to a number of observers. The end of the tube was allowed to radiate into the open air, and the intensity varied while the observer indicated when the sound passed above and below his threshold of hearing. The observed minimum intensities for audibility were very similar for a number of observers. They corresponded to a pressure variation of $1{\cdot}2 \times 10^{-3}$ dynes/cm.^{2} R.M.S. at 410 cycles and $0{\cdot}9 \times 10^{-3}$ dynes/cm.^{2} R.M.S. at 646 cycles. The corresponding energy fluxes are $3{\cdot}4 \times 10^{-8}$ erg./cm.^{2} sec. and $2{\cdot}1$ erg./cm.^{2} sec.

Lead Borates

A KNOWLEDGE of the system $PbO\text{-}B_2O_3$ is of importance in the manufacture of ceramic glazes and glasses, and a study by well-known methods involving quenching and petrographic examination has been made by R. F. Geller and E. N. Bunting (*J. Res. Nat. Bur. Stand.*, 18, 585; 1937). Four compounds were characterized, namely, $4PbO,B_2O_3$ occurring in two forms and melting congruently at 565°; $2PbO,B_2O_3$ occurring in two forms and melting incongruently at 497°; $5PbO,4B_2O_3$ melting incongruently at 548°; and $PbO,2B_2O_3$ melting congruently at 768°. No evidence of compounds richer in B_2O_3 was obtained, although these have previously been reported. Particular attention was given to the proof that the compound $5PbO,4B_2O_3$ is not the metaborate (PbO,B_2O_3). The eutectic of lowest melting point, 493°, was composed of 88 per cent PbO and 12 per cent B_2O_3. The report also gives the indices of refraction and optical characters of the compounds, and the indices of refraction, coefficients of expansion and softening points of some lead borate glasses.

Isotopes of Potassium

THE abundance ratio for the two principal isotopes of potassium, K^{39}/K^{41} (the exceedingly rare isotope K^{40} is responsible for part and possibly all the radioactivity) in various animal tissues has been measured by J. H. Yoe and R. T. Hall (*J. Amer. Chem. Soc.*, 59, 869; 1937) by means of the mass spectrograph. Any process which concentrates K^{41} will doubtless concentrate K^{40}, and as speculations have been made on the possible biological importance of potassium, owing to its radioactivity, it was of interest to see whether the abundance ratio varied in different tissues. The results showed that the ratio for most organs is close to the value found for most plants and minerals and for ocean water. A few tissues, such as the lining of the auricle and the lining of the small intestine, appear to possess an abnormally high concentration of K^{39}, whilst bone marrow is abnormally high in K^{41}. The atomic weight of potassium was calculated, with the most probable value of the packing fraction and the conversion factor; for most tissues it is 39·094. Since all deviations from this normal value are small, it does not seem probable that potassium in animal tissue could be distinguished from mineral potassium by radioactive measurements as has been suggested by some investigators. The results with bone marrow indicate a possible relationship between the abundance ratio and the age of the animal, and hence with the development of embryonic cells within the organism.

The International Congress of Agriculture

MEETING AT THE HAGUE

THE seventeenth International Congress of Agriculture was held at The Hague on June 16-24. Great Britain was officially represented for the first time for many years, though at recent congresses members of the Women's Institutes and the Horace Plunkett Foundation have been present. There is always a tendency in Great Britain to regard international congresses, other than those of specialists, as somewhat in the nature of 'joy-rides'. Languages undoubtedly present a difficulty that weighs more upon our people than upon Continentals, and this applies more particularly to those informal discussions and personal contacts from which those who participate in the Congress gain most.

The abstention of British representatives of agriculture from this Congress has most probably been due to the feeling that their industry is fundamentally different from the European system, in which peasant farming predominates. However, nowadays nearly all nations have embarked upon policies of control and regulated marketing, about which there is much to be heard from the Continental experiments, which aim like our own at the safeguarding of an industry ill-adapted to hold its own under modern conditions. From every nation one hears the same tale of low prices, of the inability of the farmer to hold his own against the trader or to get his products to the consumer at prices commensurate with those which he receives, and of the drift of men from the land. A 'Green International' is not possible, so diverse are the interests and the organization of the land and the farmers in different countries, but one's domestic policy is more likely to be successful if it is informed of what is going on elsewhere.

From the technical side, Holland is the country most worthy of study by the British farmer; its agriculture is highly accomplished and works under conditions of mixed capitalist exploitation and small holders, analogous to our own. Livestock bulk large in the system and the organization either of registration, disease prevention, advice, even of shows, affords us much to think about. The production of sugar from beet is higher in the Netherlands than in any other country—for the years 1926-29, 4,000 lb. per acre as against 2,500 lb. in Great Britain. Vegetable growing exhibits an exceptionally high general level of efficiency, even if some of our experts need fear no comparison.

It was therefore somewhat of a lost opportunity that British representation at the Hague Congress, except in the women's section, was still so limited. The formal opening was attended by H.R.H. Prince Bernhard and a representative of the Queen, the Prime Minister of the Netherlands and the Minister of Agriculture, the Minister of Agriculture of Italy, the president and secretary general of the International Institute of Agriculture at Rome, and representatives of forty nations in all. In welcoming the Congress, M. Colijn, Prime Minister, made a courageous speech on the necessity of breaking down the trade barriers between nations which have so often been set up in response to the pressure of particular interests. This was followed by a remarkable demonstration, at which the representatives of one country after another affirmed that the maintenance of peace was the prime necessity for the maintenance of agriculture and indeed of the world's civilization.

Then, as is customary, the Congress resolved itself into its various committees. The first and third sections, dealing with agrarian policy and co-operation respectively, bore perhaps little upon British conditions, though the discussion on the international market for butter was of interest to the Dominions. The second section discussed education and propaganda, and the chief point raised was the importance of economic studies in the agricultural colleges as a means of preparing trustworthy leaders of opinion in these times when so much legislation affecting agriculture is being proposed. The fourth section, on plant production, produced discussions on the improvement of protein yield from light soils and on vernalization, with some reference to the recent clash between the advocates of vernalization and the geneticists in Russia. Of great interest was the account of recent legislation in Germany to restrict the number of varieties of farm crops that can be offered for sale, a restriction dependent upon an organization for testing the productivity of the immense number of varieties that are more or less in cultivation. It was reported, for example, that from the 348 varieties of wheat formerly to be found in Germany, only 11 may now be sold, with a further 34 under trial. The vexed question of assuring to the breeder of a new variety protection analogous to that of a patent was discussed at some length. If legislative control is obtained of the varieties that may be offered for sale, it is possible to secure royalties on the stocks multiplied from the original which has been duly characterized and registered, but while something is thus practicable internally, the situation is complicated by the existence of international trade and the lack of any general system of testing and registration. In the section on livestock production, discussion chiefly turned on the role of vitamins and mineral accessories, and several of the papers presented merit careful consideration.

In the woman's section the chief report had been prepared by Mrs. Haldane, on public health regulations in English villages. The role of the woman in agriculture is obviously much larger in the European countries than in Great Britain, owing to the predominance of peasant farming; hence the greater attention that is being paid to instruction in the domestic economy of the farm.

The Congress was admirably prepared and organized; before the meetings copies were available in French of the reports and of the main communications. It might, however, well be laid down that a speaker whose paper has been printed should not read it at length, particularly in a language in which he is not at home; in some sections the time for discussion was seriously curtailed by this.

The Congress was followed by excursions to the reclamation works of the Zuider Zee, the experiment station at Wageningen, and to farms representative of the milk production and market gardening industries.

The National Physical Laboratory

INSPECTION BY THE GENERAL BOARD

THE annual inspection of the work in progress at the National Physical Laboratory was made on June 22, by the General Board and also by about two thousand visitors, who were received in the High Voltage Laboratory by Sir William Bragg, president of the Royal Society, chairman of the Board, Lord Rayleigh, chairman of the Executive Committee, and Sir Frank Smith, director of the Laboratory. Amongst the numerous exhibits in the eight departments of the Laboratory the following may be mentioned.

A comprehensive investigation into the thermal properties of a number of alloy steels is being made in the Physics Department up to temperatures of the order of 800° C. The thermal and electrical conductivity, specific heat, latent heat at the transformation points, and thermal expansion, are measured *in vacuo*. The specific and latent heats are determined by measuring the rate of rise of temperature of a hollow cylindrical specimen in which an electric heater is embedded. Loss of heat by radiation is avoided by surrounding the specimen with a jacket of low thermal capacity, which can be adjusted always to the same temperature as the specimen. The thermal conductivities of a large variety of materials are also measured in this section, the method generally employed consisting in the determination of the electrical energy required to maintain a known difference of temperature across a specimen of slab or cylindrical form, lateral flow of heat either being annulled by some form of guard system or else determined by a separate experiment.

In another building the apparatus used for the accurate realization of various points on the International Temperature Scale was shown, and the routine testing of various types of thermometers was demonstrated. It should be mentioned here that approximately half a million clinical thermometers have been tested at the Laboratory during the last year.

The radiological work done at the Laboratory can be divided into two sections, one devoted to the precise measurement of the properties and intensities of X-rays and gamma rays and the other to the application of radiography and diffraction methods to the study of the structure of materials. This latter has now become a valuable experimental tool, and typical results obtained by it on electro-deposited, heat-treated and strained metals, tooth-enamel and dentine were shown. A considerable amount of radium has been tested lately, and a valve amplifier apparatus for facilitating this work was demonstrated. The lead equivalents of various building materials to X-rays of different hardness have also been investigated, and the superior performance of barium concrete in this respect was illustrated.

A popular exhibit in the acoustics laboratory—which is at present in process of enlargement—was designed to test the efficacy of various anti-drumming treatments applied to metal panels representative of the bodywork of vehicles. The panel under test is held in a rigid square frame which is attached to a moving-coil loud-speaker movement at each corner and thereby driven at any desired frequency. The acoustic output is measured over a range of frequencies. The measurement of the absorption coefficient of sheet material was also demonstrated in the reverberation room, and a portable instrument for the measurement of noise, in which the peculiarities of the average human ear in this respect have been copied, was shown.

In the Optics Division, apparatus for measuring the intensity-response function of thermopiles and also the time-constant of this response was demonstrated. In the latter, the thermopile is connected to a condenser which is discharged through a ballistic galvanometer by an adjustable time-switch. Amongst the numerous exhibits here devoted to the measurement of colour a spectrophotometer for opaque surfaces was noted. The feeble intensity available from such a surface is counteracted by using a zonal concave mirror which focuses the light received from the specimen on to a photo-electric cell.

The Electrical Standards Division is now in a strong position with regard to the absolute determination of the ohm, inasmuch as the value finally obtained by the A.C. method devised by Albert Campbell has been found to agree to within 1 part in 100,000 with that obtained by the Lorenz machine. The apparatus used in these refined measurements was exhibited and the precautions necessary to attain the required accuracy were illustrated. Amongst other exhibits in this section was a simple form of apparatus for calibrating audio-frequency oscillators, using 50-cycle A.C. mains as a standard. The 50-cycle wave-form is distorted by passage through a metal rectifier and then mixed in suitable proportions with the oscillator output. The resulting combination is passed through a telephone in series with another metal rectifier, and integral multiples of the mains frequency are revealed by the presence of beats. A new type of quartz ring oscillator which will form the principal unit in a standard clock for the Royal Observatory, Greenwich, was also shown, together with the quartz bars used in a recent experiment, which showed that the frequency of vibration of these bars remains constant to ± 4 parts in 10^{11} irrespective of their orientation in a horizontal plane. This has been cited as being the highest precision ever achieved in a physical measurement.

In the Electrotechnics Building, the standard apparatus for the routine testing of alternating and direct current meters of all kinds was shown. The functioning of the thyratron stroboscope recently developed was illustrated by cathode ray oscillograms of the current in various parts of the operating circuit, and the results of a comprehensive theoretical and experimental investigation into the eddy-current losses in square-section alternating current conductors were also shown here.

The work in the High Voltage Laboratory is mainly carried out with impulsive voltages, and cathode ray oscillograms illustrating the work recently done were exhibited. In addition, the testing of a pin insulator with simultaneous alternating and impulsive voltages was demonstrated, and the relation between the phase of the impulse and the probability of an ensuing power arc illustrated. The demonstration of high voltage sparks proved, as usual, to be a very popular exhibit.

In the Photometry Building, an exhibit which attracted attention was concerned with street lighting. A cinema film was prepared from a series of photographs of a night street scene and the projected image viewed from a definite position. On recognizing the change from one scene to another, the observer presses a key which operates the shutter of a camera, thereby recording the instantaneous position of the film, and hence the delay in recognition. This has been carried out with various sources of illumination in order to find out if any of them have advantages from this point of view. In this building there were also exhibits illustrating the routine testing of electric lamps, maintenance of photometric standards, and other illumination research. The photo-electric spectrophotometer recently developed was shown in operation: this has materially reduced the time and tedium involved in visual measurements of this nature.

In the Radio Department the chief exhibits, which were shown on the same occasion last year, were a direction-finding radio receiver for use on wavelengths between 8 and 10 metres, a self-checking, direct-reading, frequency-measuring equipment for the range 1–70 megacycles per second, which is based on a standard 1,000-cycle tuning fork, and a number of coils and condensors of very low or adjustable temperature-coefficients of reactance.

The synchronization of a pulse transmitter and receiver, such as are used in the ionosphere research of the Radio Department, where the frequency of the exploring waves may be varied over the range 1–20 megacycles per second, has been effected automatically. The receiver is tuned by means of a small reversible electric motor, suitably geared down, which is controlled, through a system of relays, by currents which depend on the difference in frequency between the transmission and the frequency-change oscillator of the receiver.

An interferometer for routine measurements of block gauges which was exhibited in the Metrology Department has very materially decreased the time occupied by such tests. A series of gauges is wrung radially on to a circular lapped plate which is rotated so that each is viewed successively in light of four monochromatic radiations from a cadmium lamp. By estimating to 1/10th of a fringe for each radiation, the amount by which the path-difference between light reflected from the surfaces of the gauge and the plate differs from an integral number of wave-lengths, and knowing the approximate thickness of the gauge, the true thickness may be determined rapidly and without ambiguity. Amongst the new exhibits in this Department was a comparator sensitive to a millionth of an inch, and a circular dividing table reading to 1 second and accurate to 5 seconds of arc, in which the driving mechanism and the reading mechanism are entirely separate, so that the latter is not subject to wear.

An appliance for measuring the drunkenness (that is, departure from a true helix) of screw threads was shown. A pair of round-nosed feelers attached to a floating carriage register in the vee-groove of the screw at opposite ends of a diameter. Rotation of the screw produces axial movement of the feelers, and any inequalities in the movements of the two feelers is revealed on a dial gauge capable of detecting errors as small as 0·00005 inch. A horizontal projection machine has just been completed. By using suitable lenses, plate gauges up to 3 inches in length can be projected as a whole to a magnification of 25, the maximum error over any part of this field not exceeding 0·0002 inch, whilst the threads of screw gauges up to 8 inches in diameter, and the teeth of large gear-cutting hobs, can be examined at a magnification of 50. An experimental machine for testing the wearing qualities of gauge steels consists of a lapping table on which three ring-shaped specimens rest. The table and the specimens all rotate slowly about their own axes, thereby reproducing a lapping operation.

The combined fatigue testing machine developed in the Engineering Department was in operation on specimens of cast material for use as crankshafts. The high resistance to fatigue of these materials has emerged from the results so far obtained, and a law has been devised determining the behaviour of cast materials under conditions of combined bending and torsional fatigue stresses. Another exhibit of interest showed the results of fatigue tests under corrosive conditions, and the effect of using protective coatings to combat the deleterious effects thereby obtained on a number of steels. Amongst the exhibits connected with problems of lubrication, the influence of small quantities of water on the lubricating value of a motor-car oil was shown. In a journal-bearing machine, a reduction of seizing temperature from 200° C. to 140° C., and an increase of about 40 per cent in the minimum friction, was obtained, with only 0·05 per cent of water.

In the Metallurgy Department the development of magnesium alloys has continued, and data showing the valuable properties possessed by certain alloys containing aluminium and cerium were illustrated. In the rolling mill, the technique of working these alloys was demonstrated, and some very clean examples of forged and machined work were exhibited. A careful exploration of the delta region of the iron-carbon system has recently been made, using materials of the highest purity *in vacuo*. The results were exhibited in the form of the constitution diagram of this particular region of the iron-carbon system. The iron used in this and other researches is prepared in the Department by reduction of ferric oxide in hydrogen. The vacuum fusion method of determining the oxygen content of steels has been improved in reliability by the removal of gases from the apparatus at 2,200° C., thereby reducing both the correction to be applied and the time taken to carry out a test. The main results of the work which has been done on dental alloys for several years were summed up in a model, which shows the relation between the composition of the alloy and its volume change during setting. The narrow limits within which a satisfactory alloy lies were thus well illustrated. Experiments have been made in this Department on the diffusion of gases through wood. With hydrogen diffusing across the grain, it has been found that the rates vary by as much as 2,500 to 1, depending on the variety of wood under test.

The electron microscope is being developed as an experimental tool, and a magnified image of a very fine wire gauze was exhibited to show some of the possibilities of this instrument.

In the Aerodynamics Department the pitot-traverse method of measuring aerofoil drag appears to be now more widely used, and satisfactory agreement has been obtained between this and balance measurements. The drags of a number of aerofoils with various surface finishes have been measured in the compressed air tunnel up to a Reynolds number of 24 millions. Similar experiments on a thin aluminium plate with suitably shaped leading and trailing edges have given very good agreement with the theoretical curve for turbulent flow over a flat plate except at low Reynolds numbers, where the experimental curve tends to fall to the theoretical curve for laminar flow. Two other exhibits in this Department were devoted to the investigation of the transition from laminar to turbulent flow along the boundary of an aerofoil, one employing a visual—or photographic—method, and the other a hot-wire method of detection.

In the large 'duplex' wind tunnel the effect of the slipstream from the propellers of a model monoplane on the stability of the model was being studied, the propellers being driven by an internal electric motor. Another exhibit of interest here was concerned with the problem of wing flutter. The aerodynamic forces acting on a wing section subjected to a sinusoidal pitching motion are measured by the aid of a magnetostriction stress recorder. The high-speed tunnel, which operates by induction from the exhaust from the compressed air tunnel, has been employed in the investigation of the behaviour of aerofoils up to speeds of more than 600 miles per hour, where the effects of the compressibility of air attain a predominating importance.

Experiments on the improvement of ships' lifeboats enabling them to avoid shipping seas in rough water were in progress in the William Froude Laboratory, and the results obtained with a model have been confirmed by full-scale trials of a lifeboat of the best design. Tests were also being made in the new tank on a model propeller partially immersed in water, as for a ship in ballast condition. Automatic records of thrust, torque, revolutions, etc., are made at different immersions. By means of a stroboscope, the action of the blades upon the water during emersion and submersion is observed. It should be noted that during 1936, 88 ship designs were tested in this Laboratory, representing 80 per cent of the merchant shipping listed as "under construction" in Great Britain.

University Events

Cambridge.—Dr. H. J. Bhabha, of Gonville and Caius College, has been awarded an 1851 Exhibition studentship.

The General Board recommends that three additional part-time University lectureships in zoology be established from October 1; that an additional University demonstratorship in zoology be established from October 1, and that a readership in invertebrate zoology be established for one tenure only, and that the General Board be authorized to appoint Dr. C. F. A. Pantin to this post from October 1.

Dr. R. N. Chopra, of Downing College, has been approved for the degree of Sc.D.

At Christ's College, Dr. R. D. Davies, of Gonville and Caius College, has been elected into a research fellowship. Dr. Davies was elected to a Salomons engineering scholarship in 1921, and was placed in Class I of the Mechanical Sciences Tripos in 1922. He is a University demonstrator in engineering and was formerly a captain in the Royal Engineers.

Sir David Chadwick, formerly a scholar of Sidney Sussex College, secretary of the Imperial Economic Committee and of the executive council of the Imperial Agricultural Bureaux, has been elected an honorary fellow of Christ's College.

London.—University postgraduate studentships of the value of £150 for one year have been awarded to W. J. Allum (Imperial College—Royal College of Science), W. J. Arrol (Queen Mary College and Imperial College—Royal College of Science), Elizabeth Carey (University College), J. A. Kitchener (University College), D. McMillan (University College), J. D. Marcantoni (Queen Mary College), Dorothee Metlitzky (University College), A. A. Ruddock (University College, Southampton) and Elizabeth Sweeting (Royal Holloway College).

The University studentship in physiology of the value of £100 has been awarded to J. P. Quilliam (University College) who will carry on physiological research at University College.

O. A. Saunders has been appointed as from October 1 to the Clothworkers' readership in applied thermodynamics tenable at the Imperial College—City and Guilds College. Since 1932 he has been lecturer in applied mathematical physics at the College.

Oxford.—Sir Farquhar Buzzard, Christ Church, and I. O. Griffith, Brasenose College, have been elected to the Hebdomadal Council.

Dr. A. D. Gardner, University College, has been appointed to the new readership in bacteriology as from October 1. The title of professor has been conferred on Dr. A. D. Gardner. Dr. A. H. T. Robb-Smith has been appointed assistant director of pathology at the Nuffield Institute.

The senior mathematical scholarship for 1937 has been awarded to G. L. Camm of Balliol and New Colleges.

Dr. H. M. Sinclair, Oriel College, has been elected to an official fellowship and tutorship in physiology at Magdalen College. Miss M. G. Adam, senior scholar of Lady Margaret Hall, has been appointed assistant tutor in science at St. Hugh's College. At Christ Church, J. F. Hope Simpson (Balliol College) has been elected to a senior scholarship for work in botany and J. A. Moy-Thomas re-elected to a lectureship (the equivalent of a research fellowship) in zoology.

J. A. Boycott, Brasenose College and Miss E. J. Cockram, Society of Oxford Home-Students, have been granted degrees of M.D. Dr. N. C. Wright (Christ Church), of the Rowett Institute, has been granted the degree of D.Sc. for his work on proteins.

At Queen's College, M. Abercrombie has been elected to a junior research fellowship for work in zoology and E. P. Abraham, New College, to a taberdarship for work in chemistry.

R. Campbell Thompson, Merton College, has been elected Shillito reader in Assyriology in succession to the late Prof. S. Langdon.

St. Andrews.—At a graduation ceremonial to be held on September 28 in connexion with the celebration of the quater-centenary of St. Mary's College, the honorary degree of LL.D. is to be conferred on Sir Leonard Woolley, archæologist, among others.

The following appointments have recently been made: J. Dewar to be lecturer in chemistry in the United College, St. Andrews; T. G. Cowling to be lecturer in mathematics, and R. E. Stedman to be lecturer in philosophy, both in University College, Dundee.

Science News a Century Ago

The Grand Junction Railway

THE most important addition to the railways of Great Britain in 1837 was the Grand Junction Railway, uniting Birmingham with Liverpool and Manchester. The Bill for the line had been passed in 1833, and in 1834 the directors appointed George Stephenson and Joseph Locke as joint engineers. Stephenson withdrawing in August 1835, Locke became engineer-in-chief, and the line was constructed under his supervision. The opening of the line took place on July 4, 1837, when a train left Newton on the Liverpool and Manchester Railway at 7.0 a.m. and, after stopping at Crewe, Stafford and other places, finally arrived at Birmingham at 11.30 a.m. The distance was 82½ miles. Describing the events of the day, the *Morning Herald* said : "From Wolverhampton to Birmingham a general holiday appeared to be observed and the scene was highly interesting both to the observed and observers. Tents were pitched in several fields, and parties given by the respective tenants in honour of the day. The weather was extremely beautiful, and the freedom from dust which exists on railways is another interesting feature connected with this branch of mechanics." Among the most notable works on the line was the Dutton Viaduct, over the valley of the River Weaver.

Death in the Candle

UNDER this sensational heading the *Lancet* of July 8, 1837, contains the following account of a meeting of the Medico-Botanical Society held on June 28 : "Mr. Everett detailed the results of several experiments made with the view of ascertaining the constituents of some 'new composition candles' which have lately been much employed by the public. His attention had been called to the subject by his having detected a strong garlic odour from the burning candles similar to that given out during the combustion of metallic arsenic. He purchased candles from various vendors of them, and, after considerable trouble, discovered a method by which he could collect a large quantity of the condensed smoke given out during their burning. He broke off the bottom of a glass retort with a very long neck, and placed the burning candle under it, the smoke having to traverse the lengthened tube was deposited on its sides. On carefully collecting this matter, and subjecting it to all the most unequivocal tests for arsenic, that metal was in every instance detected. The quantity contained in each candle would, according to the quantity collected by the experimenter, be about two grains ; but in consequence of the difficulty in preventing the escape of a large quantity of the smoke, he considered that double that quantity might be fairly inferred to be present. He supposed the makers of the candles used this metal for the purpose of giving the candles a better appearance, and to give them a higher melting point, and this had since been acknowledged to him by a manufacturer of them, as the fact, the arsenic being found an excellent substitute for a small quantity of wax which answered the same purpose. Now, the question was to be decided whether or not this quantity of arsenic burnt in a room was injurious. . . . He (Mr. E.) would say that the vapours of metallic arsenic were fully as if not more noxious than those of sulphuretted hydrogen."

Medical Practitioners in Russia

THE *London Medical Gazette* of July 8, 1837, contains the following account of medical practitioners in Russia at that time :

"There are several classes of practitioners, but the deference paid to each is not in a ratio with their medical, so much as their military or civil rank. The degrees conferred by the universities are the following : Physician, Surgeon-in-Chief ; Surgeon-in-Ordinary ; Staff Surgeon ; and Surgeon's Mate ; Hospital Mate ; Barber Surgeon ; Apothecary. In general practice there is no positive distinction in the labours allotted to the first three ranks. The physician and the surgeon, in most cases, practise indiscriminately all branches of the profession. The physician receives homage from the surgeons, takes precedence as he passes through the wards of the hospital, signs documents and makes valid his rank by several operations. The hospital mates dressed in military uniform, march up and down the wards, half face about and stand to attention, as their superiors command them. The hospital mates and surgeon's mates are completely under military control, although attached to civil institutions. The apothecaries . . . are mere vendors of drugs and preparers of recipes, and their shops are all licensed by Government. . . . The last class is the *Tsirulnik* or barber surgeon, and is a numerous and thriving brotherhood. It falls to their lot to bleed, cup, draw teeth, apply leeches, and perform other little odd jobs of minor consequence. . . . There are no distinct aurists ; aural surgery forming part of the practice of ordinary surgeons. There are likewise but few oculists who devote their whole time to diseases of the eye. Many physicians and surgeons include the treatment of these diseases in their general practice. Dentists abound in every street, and their profession is perfectly distinct, and not within the pale of the medical faculty. There are no distinct chiropodists in Russia."

Schönbein and Faraday

ON July 9, 1837, Schönbein wrote to Faraday, sending him copies of a book containing an account of his researches on iron dedicated by Schönbein to Faraday. He expressed his regret at not being able to visit England for the meeting of the British Association, and asked that a copy of his book might be presented to the Association if such gifts were received.

In the course of his letter, Schönbein said : "The other day I got a letter from Mr. Berzelius, the contents of which relate to my observations on the peculiar state of Iron. The distinguished Chemist, though he does not yet give a decided opinion upon the subject, is inclined to think, that in one notice of yours, published some time ago in the *Phil. Mag.*, which alludes to the observations of Ritter and de la Rive regarding the secondary poles and the electrical state of polar Platina-wires, the true cause of the inactivity of Iron is hinted at. According to the view of Berzelius, Iron performing the function of the positive Electrode undergoes a change with regard to its primitive electrical condition in such a manner as to be turned from a positive electrical body into a negative one. As my views with respect to electrochemical subjects essentially differ from those of Berzelius', I cannot on this account think the ideas of that Philosopher correct. . . ."

Societies and Academies

Dublin

Royal Irish Academy, January 25.

E. J. CONWAY, J. M. O'CONNOR and D. K. O'DONOVAN: *Influence of temperature on the activity of the kidney in relation to its influence on oxygen consumption.* Expressing the secretory activity as an energy equation—with free passage of urea across the tubular cells—the slope of the oxygen consumption of the animal and that of the activity of the kidney with temperature are identical. On the curve of activity with temperature there appear three main phases similar to those on the oxygen curve, the latter being already described (O'Connor, *Proc. R.I.A.*). The diurnal variations of body temperature in the normal human subject (96·4°–98·6° F. in the subject investigated) also show a temperature effect similar to that on total oxygen consumption, with minimum at 97·2° F., and the two main phases already described for renal activity (Conway) receive a satisfactory metabolic explanation. The lowest energy requirement for the maximum urea secretion was computed on the most general basis of an active secretion process, and found to be of the same order as that derived from the experimental values of the oxygen consumption as given in the general literature.

February 22.

E. J. CONWAY: *Structural laws of the mammalian kidney with theoretical derivations.* Details of certain structural laws of the mammalian kidney with theoretical derivation were presented. These were already briefly announced in NATURE of February 6, and referred to the agreement of the actual relationships with the following theoretical equations:

n (number of tubules) = $W^{0\cdot444}$ × a constant.
l (length of the first convoluted tubule) = $W^{0\cdot222}$ × ,,
g (diameter of the glomerulus) = $W^{0\cdot111}$ × ,,
d (diameter of the first convoluted tubule) = $W^{0\cdot000}$ × ,,

Paris

Academy of Sciences, May 10 (*C.R.*, 204, 1377–1448).

ALEXANDRE GUILLIERMOND and ROGER GAUTHERET: The conditions under which neutral red produces the vital coloration of the vacuoles. For most of the fungi studied, the vital coloration of the vacuoles with neutral red is only possible in cells which have their growth arrested: as soon as the cells start growing they are decolorized. *Saprolegnia* and roots of wheat behave differently, and always accumulate neutral red at the commencement of their growth.

JEAN BOSLER and HENRI ROURE: The disappearance of Biéla's comet. In 1867, C. Bruhns pointed out that Biéla's comet in January 1846 passed near the orbit of the Leonids; if the orbits met, this might account for the disappearance of the comet. The author's calculations confirm those of Bruhns.

NICOLAS KRYLOFF and NICOLAS BOGOLIOUBOFF: Probabilities *en chaine.*

Z. WARASZKIEWICZ: Topologically homogeneous plane curves.

CHI-TAI CHUANG: A generalization of a theorem of Valiron.

ROBERT FORTET: The iteration of certain linear substitutions.

HENRI MILLOUX: The meromorph functions in a circle.

ARNAUD DENJOY: The approximation of certain sums.

DE MIRA FERNANDES: The calculation of the energy of acceleration of a solid body.

LUCIEN MALAVARD and JOSEPH PÉRÈS: The boundary wall corrections in elliptical wind chambers.

GUSTAV ANDRÉ MOKRZYCKI: The work required from starting an aeroplane to the point at which it leaves the ground.

JEAN LOUIS DESTOUCHES: The interaction of two corpuscles in relativistic wave mechanics.

JEAN ROUBAUD-VALETTE: The interpretation of the operators employed by Dirac by means of the fundamental magnitudes of hyperspace.

PHILIPPE TONGAS: A new empirical expression for the total heat of superheated steam. .

THÉODORE V. IONESCU: A new oscillator with very short waves (microwaves). The apparatus described and illustrated gives an oscillation of wavelength 36 cm.

MME. ARLETTE TOURNAIRE-VASSY: The relative measurement of the absorption coefficients of ozone in the region of the Chappuis bands.

LÉON CAPDECOMME and PIERRE JACQUET: The reflecting power of copper. Polishing by the anodic method gives copper surfaces the reflective power of which is more constant and less alterable than surfaces obtained by the usual mechanical method.

MLLE. WILLY A. LUB: The optical spectrum of actinium. Actinium is the only element the optical spectrum of which is unknown. Starting with lanthanum oxide containing actinium, the wavelengths of seven new lines have been measured which appear to be due to actinium.

F. BARILLET and MLLE. A. CHOISNARD: The evolution of the interfacial tensions in the neighbourhood of saturation.

FRANÇOIS BOURION, E. ROUYER and MLLE. O. HUN: The determination of the individual hydration of the ions.

MLLE. HENRIETTE SCHUHLER: The ultra-violet spectral properties of salicylic acid as a function of the *p*H.

VICTOR AUGER and MLLE. NINA IVANOFF: The molybdenum blues. A phosphoceruleomolybdic acid.

HALDUN N. TEREM: The corrosion of beryllium bronzes.

GEORGES LAUDE: The formation of ammonia by boiling some proteins with solutions of potash.

ROGER DE LARAMBERGUE: The synthesis of cyanamide by the oxidation, in the presence of ammonia, of some sugars, lævulose, arabinose, mannitol and glycerol.

FRANÇOIS KRAUT: The breccias and conglomerates of the neighbourhood of Rochechouart (Haute-Vienne).

ANTONIO DE MEDEIROS GOUVÊA and GEORGES ZBYSZEWSKI: Observations on the Portuguese coast between the mouth of the River Odesseixe and that of Rio Mira.

ROBERT LAFFITTE: Some levels containing Foraminifera of the Cretacean at Aurès (Algeria).

JOSUÉ HEILMANN HOFFET: The Cretacean of Bas-Laos.

LÉVI HERMAN and MME. RENÉE HERMAN-MONTAGNE: The meaning of measurements relating to the quantity of dust or smoke shown at the ground-level.

Jean Chaze : The production of choline in the caryopses and seedlings of darnel, in relation with parasitism.

Henri Marcelet : The presence of a new C_{19} alcohol in the wax extracted from the oil of the fruit of the raspberry.

Georges Brooks : The phosphorescent mineral matter in the bony tissues of the frog (*Rana esculenta*).

Amsterdam

Royal Academy (*Proc.*, **40**, No. 5, May 1937).

J. F. Schouten : The role of electric, photochemical and diffusion phenomena in vision. Quantitative determinations of the change in the sensitivity of the fovea produced by stimulation of a part of the retina by light.

F. A. Vening Meinesz : The gravity expedition of the Dutch submarine *O16* in the North Atlantic, January 11–March 16, 1937.

W. H. Keesom, Miss H. van der Horst and K. W. Taconis : Measurements concerning the volumes of mercury menisci. Determinations carried out by an X-ray method.

W. H. Keesom and P. H. van Laer : (1) Measurements of the latent heat of tin in passing from the supraconductive to the non-supraconductive state at constant temperature. (2) Relaxation phenomena in supraconductivity.

A. A. Nijland : Mean light curves of long-period variables. (28) Z. Ceti. (29) U. Persei. (30) S. Lyncis.

H. R. Kruyt and J. Oosterman : Flow potentials on platinum.

J. ter Berg and F. M. Jaeger : The possibility of distinguishing right- and left-handed structures in crystals by means of their Laue patterns.

P. E. Verkade, J. van der Lee and A. J. S. van Alphen : Researches on fat metabolism (10). Feeding experiments on dogs with simple saturated triglycerides.

H. A. Brouwer : Metamorphic rocks at Torne Träsk (Lappland).

K. Mahler : Arithmetic properties of a class of decimal fractions.

V. Levin : Two remarks on van der Corput's generalization of Knopp's inequality.

W. H. Arisz and J. Oudman : (1) Influence of aggregation on the transport of asparagine and caffeine in the tentacles of *Drosera capensis*. (2) Transport of introduced nitrogeneous substances in the leaves of *Vallisneria spiralis*.

L. A. H. Bouwman : A new species of the genus *Sabinia*.

G. P. Frets : The relation of head length and head index of Johannsen and the spurious correlation of Pearson.

Moscow

Academy of Sciences (*C.R.*, **14**, No. 5 ; 1937).

S. Finikov : Laplacean suites with two projectively applicable congruences.

A. Andronov and L. Pontrjagin : Gross systems.

E. Leontovič and A. Mayer : Trajectories which determine the qualitative structure and the division of the sphere into trajectories.

L. Kantorovič : The sequence of linear operations.

H. Hilmy : A property of the minimal ensembles.

S. N. Vernov : Measurement of cosmic rays in the stratosphere at the magnetic latitude 35°.

A. S. Kompaneietz : Absorption of sound by crystals at high temperatures.

S. A. Ukholin : Influence of temperature on the combined spectrum of carbon tetrachloride in the liquid and gaseous states.

P. Bažulin : Influence of temperature on the absorption of ultra-sonic waves by benzene and carbon tetrachloride.

P. P. Lazareff : Thermic theory of changes in the peripheric visual sensibility due to geophysical causes.

P. P. Lazareff and I. A. Lourié : Adaptation in peripheral vision in normal and imbecile infants.

K. A. Krakau, E. J. Mukhin and M. S. Heinrich : Equilibrium diagram of the ternary system Na_2SiO_3—$PbSiO_3$—SiO_2.

S. Frisch : The $^3P_0$—^3P term combination in the arc spectrum of cerium.

V. V. Čelincev : Compounds of chinones with HCl, H_3PO_4, CH_3COOH, and their chlorination.

N. K. Pšencyn : A new type of iridium compound.

A. V. Solovjev : Electrochemical investigation of the anti-corrosive properties of sodium nitrite.

A. F. Sosedko : Geochemical diagram of pegmatites of the principal arcs of mountain chains of Central Asia.

J. Larionov and J. M. Tolmačev : Chemical composition of cassiterites.

M. Gudlet and E. Kardo-Sysojeva : Oxidation of ascorbic acid (vitamin C) in plants.

V. S. Sadikov : A new method of isolating amino acids, peptides and cyclopeptides from protein hydrolysates.

J. D. Poljakov : A new apparatus for measuring the oxygen consumed by small aquatic animals.

Vienna

Academy of Sciences, March 11.

Ludwig Eckhart : Affine representation and axonometry. A method is given for the construction of the projection of a body in any plane from its ground plan and elevation.

Karl Federhofer : Calculation of the normal modes of vibration of a spherical shell.

Alfons Klemenc and Walter Neumann : Exact estimation of a nitric oxide—nitrogen dioxide mixture by the methods of gas analysis.

Ernst Storfer : Precipitation of trithiourea cuprous chloride from its aqueous solution.

F. Bilger, W. Halden, E. Mayer-Pitsch and M. Pestemer : Fatty matter in yeast (5). Quantitative relations in the biological formation of ergosterin.

W. Jorde : Thermal polymerization of styrol.

Walter Häuslmayer : Chemical development of the markings of butterflies. Wings extracted from the pupa develop markings when placed in tyrosinase. This action of tyrosinase is hindered by uric acid.

Martha Geiringer : Influence of the central nervous system on the adaptation of the colour of the frog (*Hyla arborea* L.). Severing the nerve connecting the regio chiasmatica to the pituitary destroys the ability of the frog to adapt its colour to its surroundings, while leaving the eyesight unimpaired.

Gustav Götzinger : Geological analysis of the Quaternary deposits in the Traun valley region above Gmunden. The hydrographical state of the valley during various periods of recession of the main glacier is determined.

Forthcoming Events

Society of Chemical Industry, July 5–9.—Annual Meeting to be held at Harrogate.

Museums Association, July 5–9.—Annual Conference to be held at Newcastle-upon-Tyne.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Civil Engineers (male) in the Air Ministry—The Secretary (S.2(c)), Air Ministry, Adastral House, Kingsway, London, W.C.2 (July 5).

Two Chemists and **Two Junior Assistant Metallurgists** in the Royal Ordnance Factories at Nottingham and Birtley—The Chief Superintendent of Ordnance Factories (Advert. No. 144), Royal Arsenal, Woolwich, S.E. 18 (July 6).

Lecturer in Mining Subjects and a **Lecturer in Mechanical Engineering** in the Mining and Technical College, Church Street, Barnsley—The Principal (July 6).

A **Teacher of Mathematics and Physics** with a knowledge of rubber technology, in the Northern Polytechnic, Holloway, London, N.7—The Clerk to the Governors (July 7).

Lecturer in Civil Engineering at Wigan and District Mining and Technical College—The Principal (July 7).

Assistant Engineer Inspector (Mechanical) for service in Great Britain in the Office of the High Commissioner for India—The Director-General, India Store Department, Belvedere Road, S.E.1 (July 7).

A **Graduate in Mechanical Engineering** to teach mathematics and engineering subjects in the North-east Essex Technical College, Colchester—The Clerk to the Governors (July 7).

Assistant Lecturer in Mathematics in the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield (July 7).

Temporary Assistant Lecturer in Botany in the University of Liverpool—The Registrar (July 7).

Designer (Ref. No. 542 B) and **Assistants II** (Ref. No. 296 B) in the Royal Aircraft Establishment, South Farnborough, Hants—The *Chief Superintendent (July 9).*

Scientific Officer, Assistants III (male and female) in the Ballistics Directorate, Research Department, Woolwich, S.E.18—The *Chief Superintendent (July 9).*

Principal of the County Technical College, Guildford—The Chief Education Officer, County Hall, Kingston-upon-Thames (July 10).

Lecturer in Chemistry at Brighton Technical College—The Education Officer, Education Offices, 54 Old Steine, Brighton 1 (July 10).

Assistant Civil Engineers (male) in the Civil Engineer-in-Chief's Department, Admiralty and H. M. naval establishments at home and abroad—The Civil Engineer-in-Chief, Admiralty, London, S.W.1, envelope marked "A.C.E." (July 12).

City Engineer of Kingston-upon-Hull—The Town Clerk, Guildhall, Hull, envelope marked "City Engineer" (July 12).

Technical Officer in the Meteorological Office—The Secretary (S.2.A), Air Ministry, Adastral House, Kingsway, London, W.C.2 (July 12).

Lecturer in Mathematics in the Manchester Municipal College of Technology—The Registrar (July 12).

Director of the Technological Research Laboratory at Calcutta of the Indian Central Jute Committee—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (July 12).

Lecturer in Mathematics at the Cheltenham Technical College, *Lansdown Road—The Secretary (July 13).*

Senior Scientific Officer (male) in the Admiralty Scientific Pole—The Secretary of the Admiralty (C.E. Branch) (quote C.E. 4561/37) (July 17).

Chemist in the Geological Survey Department, Federated Malay States—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, London, S.W.1 (July 31).

Part-time Lecturer in Biology (woman) in Sedgley Park Training College, Manchester—The Principal.

Mechanical and Electrical Engineer in the Public Works Department, Gold Coast—Crown Agents for the Colonies, quoting M/5280.

Engineers for the Public Works Department, Somaliland—Crown Agents for the Colonies, quoting M/5076.

Civilian Laboratory Instructors at the Electrical and Wireless School, Royal Air Force, Cranwell—The Principal.

Temporary Assistant Engineers, Engineering Assistants and **Junior Engineering Assistants** in the Ministry of Transport for work in connexion with surveys of trunk roads—The Establishment Officer, Ministry of Transport, Northumberland Avenue, London, W.C.2.

Examiners in the Aeronautical Inspection Directorate Test Houses—The Secretary (S.2.d), Air Ministry, Adastral House, Kingsway, W.C.2.

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Great Britain and Ireland

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Citizenship

AT the recent conference of the Association of Teachers in Technical Institutions, Mr. W. E. Park referred in his presidential address to a report on training for citizenship for students in technical institutions which had been prepared by his Association in conjunction with the Association of Principals of Technical Institutions and the Association of Technical Institutions. The report has just been issued, and is one which we believe ought to be regarded as of first-class importance.

The reasons for our belief are not far to seek. A glance about the world reveals its present discontents with an uncomfortable vividness. The old values which seemed once so secure are fading. Human organizations, which seemed but a few years ago to be leading, however slowly, to sane and rational ends, are crumbling. Over-production on one hand and even starvation on the other become more sharply defined. Political ideas appear charged with a newer and more emotional violence. The dream of a world-State shatters down to a grim reality of nations self-contained, self-striving and living in a fear-haunted hostility which keeps us on the brink of unimaginable dangers. If we are not, at the moment, living under the actual threat of war, we are daily made aware of rearmament and the need to be prepared for what can be little else than the crash of civilization as we know it. Yet, in spite of the distinguished writer who informed us with grim curtness that we are witnessing a race between education and catastrophe, it would seem, in Great Britain, at any rate, that the world of education moves on with calm serenity and is by no means convinced that, if it neglects the problems which none of its students can ultimately avoid, it neglects a vital duty. Whatever we may think of dictator countries, they have at least learned to use the machinery of their schools. They have infused education with their own enthusiasms and made it aware of its part in the life and work of the community.

Sir Ernest Simon, chairman of the Association for Education in Citizenship, has summed up the aims of that education under four heads: a sense of social responsibility; a love of truth and freedom; the power of clear thinking in everyday affairs; a knowledge of the broad political and economic facts of the modern world. Those aims are ambitious, and we would hesitate even to attempt to sketch the means whereby they might be attained. We know perfectly well that those responsible for any kind of school can point to their time-tables and syllabuses and ask where and how they are capable of addition. They can say, broadly, that the aims are inherent in their present work. But the problem has an urgency which will not permit it to be so easily dismissed. The manipulation of time-tables and syllabuses is a matter for experts, and none would be so bold as to say that it may not be somehow used to make education that very real thing—*adaptation to environment*. Inherent qualities, too, need more discussion than the phrase sometimes permits. We have long since given up the belief that training in one subject necessarily gives facility to deal with another. If that were so, we should find that our specialists were invariably wise and their judgment, outside their specialist field, invariably sound. But we know that is not the case. The specialist in physics cannot necessarily be regarded as being free from prejudice, emotion and even ignorance when he is asked to make a judgment on the League of Nations or the need for tariff reform. Clear thinking, in short, cannot be transferred from specialist subjects to others with which the voter has to deal in everyday life.

Whatever may be done in other fields of education, then, it is clear that those concerned in technical education are to be encouraged in their attempt to view the problem of education for citizenship from the point of view of their own work; for it is a task which presents the utmost difficulties when any *direct* method of teaching the subjects which citizenship may include is attempted. Naturally, if and when other branches of education take up those subjects, it is a task which will become correspondingly easier.

A large body of the students of technical institutions are those who take part-time courses. They are engineers, chemists, builders and the like, who are already in employment. Since they attend courses on some three evenings per week, and since they have to undertake homework in addition, and since their work is directed to the attainment of some recognized professional or industrial qualification, it is difficult to see how it can be possible to secure their attendance for additional, and, at first sight, unrelated subjects. For these students there is the possibility of the 'indirect' method. If education for citizenship means training the individual for his relationship to the various communities on which he impinges, it is certainly within the bounds of possibility—to put it no higher—that specialist subjects could be used by skilful teachers so that their backgrounds, contacts and relationships could be shown in the everyday world. The discussions and debates of students' societies, too, could be used. One imagines, for example, engineering and commercial students dealing with problems of production and distribution—under happier titles, perhaps—and arriving at conclusions concerning duties and relationships which normally they might miss.

For full-time students we hope more can be done. In their case it ought to be possible to apply the 'direct' method. The introduction of studies of the social sciences, the structure of government, modern political and industrial problems would, in our opinion, be of immense value in attaining the ends we have in mind. It is not for us here to suggest the precise subjects, their method of treatment or their particular place in particular curricula. It may be that the use of daily papers—with a view to comparison of opposing views on a single issue which are so constant a feature of our modern daily Press—will take the place of the more orthodox text-book. (Such a method would, at least, train students to sift evidence and arguments for themselves rather than be swayed by the prejudice of partisan announcements.) It may be that local circumstances could be used to demonstrate problems of town-planning, means of transport, food supply, organization of community life, local and central government. Whatever the method, if an active interest in the social and political structure can be developed, the first step towards attainment of the aims of citizenship will have been secured.

It may be objected that this kind of teaching involves a danger of bringing politics into education. We would reply that, if a scientific approach to social and political problems be not taught, young people will be left unprotected, both now and in later life. Which is the greater danger ?

We would make it very clear, even to the point of what may appear unnecessary reiteration, that we have no wish to make dogmatic suggestions as to subjects or to their treatment. It is desired only to emphasize that the social sciences must, in some way, be made to keep pace with the other sciences, which are setting expected, as well as unexpected, problems to our civilization. Articles in these columns from time to time have underlined the fact that, in spite of the advances of science and the obvious advantages which these have brought to us, we stand in the face of vast dangers all of which point urgently to the need of adapting our social life to the new and changing environment which men's activities have produced. The technologist and the scientific investigator should not be allowed to work in specialized compartments with no picture of how their work is related to the rest of the community. For want of a better name, we call the presentation of that picture 'citizenship', which Aristotle saw as "the most synthetic of sciences" and, as a practice, "the most architectonic of the Arts". His notion of civics was expressed under the four types of co-operation between the labour of the people, the public functions of citizens, the meditations of philosophers, and the efforts of teachers. It is a notion which we moderns, in our present dangers, should not neglect. For that reason, we welcome the publication of the report prepared by the three technical associations, and we look forward to its implementation in no matter how experimental a form.

Man and the Machine Age

Die Tragik des technischen Zeitalters
Mensch und Maschine im 19 Jahrhundert. Von Otto Veit. Pp. 226. (Berlin: S. Fischer, 1935.) n.p.

THE book under notice deals with a problem which has become very familiar to the German philosophers, sociologists and others since the days of Nietzsche. To put it very briefly, it comes down to this: the victory of rationalism, materialism, liberalism, individualism, and the achievements of the 'technical age' which originated from the victory in question, have become a fatal gift for the human race. It is true that the introduction of machinery into productive processes enabled the population to grow more rapidly and to be supplied with material goods more abundantly than ever before; but, at the same time, there opened a wide gulf between the 'objective' and the 'subjective' culture. Mankind has become richer in material wealth; man has become poorer.

Strange as it may seem, this judgment is justified in regard not only to man's emotional but also to his intellectual qualities; the philosopher who commanded all the knowledge of his time and was able to lift it up on a higher plane has been supplanted by the specialist who confines himself to a more or less narrow sphere of scientific comprehension. The political and economic freedom for which our forefathers fought so enthusiastically has changed into a universal dependency; the maintenance of liberal institutions in some major imperialistic countries does not alter this fact, but makes it still more impressive.

Finally, liberty of thought has become a rather negative character; we know the chains from which we are free (or from which we desire to be free), but we do not know exactly for what purpose we are free. Religious dogmas have lost that influence over the human mind they formerly exerted; the same fate has befallen the belief in reason, freedom, humanity and progress, which seemed to replace the religious creeds in the period of the bourgeois revolutions. This intellectual development inevitably results in a radical relativism which may discuss every thinkable opinion without taking sides with or against any one of them, and in scepticism and nihilism.

Two roads widely differing from each other seem to lead out of the cultural crisis; the first of them was indicated at the end of the eighteenth and beginning of the nineteenth centuries by thinkers like Burke in England, de Bonald, de Maistre, Chateaubriand in France, Adam Müller in Germany. These authors held the view that not the rational analysis but the somewhat irrational intuition ought to be regarded as the supreme method of scientific research; they placed emphasis on the fact that the genuine rights of the community are superior to those of the individual; they responded to the liberal admiration of progress and future with their worship of the past, the Middle Ages in particular. Consequently, they opposed the destruction of the traditional technique by modern machinery; they wanted the application of the latter to be kept down so far as possible, if not prohibited altogether.

The second attempt at a solution of the crisis has been made by socialism. The socialists did not lag behind the romanticists in acknowledging the damages inflicted upon culture by the bourgeois revolution. But the romantic criticism is reactionary and therefore, after all, it remains hopeless; the socialists, on the other hand, try to overcome the capitalist society in a progressive manner; they do not base their verdicts on the past but on the future. The socialists demand that those regions of social life which are centred upon technique and economics ought to be organized as rationally as possible; the predominant claim of socialism, namely, the replacement of private ownership in the means of production by common ownership, means in reality that the principle of rational organization which—under capitalism—is necessarily restricted to the individual factory or trust, is to be extended over the whole field of economic relations. Nevertheless, socialist rationalism is not an end in itself; the underlying motive is the settled conviction that technique and economics, if they are to be made to serve man instead of being served by him, form the appropriate foundation of a "realm of real freedom" as it has been called by Marx.

It is very characteristic of the book under notice that Veit accepts neither the romantic nor the socialist solution. As regards his attitude towards the 'romantics', he is in accord with the vast majority of the philosophers in fascist countries, who are in agreement upon many points with the feudal and clerical enemies of the bourgeois revolution but, at the same time, do not become 'romantics' in the strict or proper sense of the word. It is obvious why. The romantic flight into the Middle Ages, the veneration of the feudal monarchy, the nobility, the church and the corporations, have never been anything else but a counter-move against the use of liberal capitalism; and even in this respect their practical significance was limited to the period when modern technique and large-scale production were at their very beginning. Such currents like national socialism (or fascism in general) have sometimes been regarded as a set-back into a precapitalist state of society from which the present civilization is to be protected. People who argue along these lines are inclined to confound the ideological veil with the social reality that the former has to cover. National socialism, in the very interests of rearmament and imperialistic expansion, is forced to develop the applied sciences; and the big profits which have been made in Germany, Italy and other fascist countries have not benefited the peasants, the handicraftsmen or the small shopkeepers but the heavy industrialists, who invest them either in their own or in similar undertakings, thus enlarging the domain of machinery and rational technique.

The charges made by Veit against his second and more dangerous adversary, dialectical materialism, testify to the fact that Marx has been more frequently criticized than understood. Veit is of the opinion that—according to Marx—the worker has been enslaved by the machine. Even a very superficial knowledge of the Marxian system gives ample proof that the above-mentioned representation of the Marxian philosophy is utterly misleading. Marx never speaks of 'the machine' without further specification, that is, without regard to the social system in which 'the machine' is being conducted, but he draws a clear and sharp distinction between the results brought about by the machine in capitalism on one hand, and in socialism on the other; this differentiation may be right or wrong, but it is impossible to criticize a thinker for ideas he never propounded.

Since Veit neither shares the romantic nor the socialist point of view (each of which is consistent in itself), his own literary contribution towards the solution of the cultural crisis remains exceedingly vague and unprecise. He does not cross the border which had already been reached by Nietzsche and others; logically he lags far behind his predecessors. Against the will of the author, his book has become a justification of that critical stage of development in the overcoming of which he wishes to co-operate.

ALFRED MEUSEL.

Palæocene Mammals

Paleocene Faunas of the San Juan Basin, New Mexico

By W. D. Matthew. (Transactions of the American Philosophical Society, New Series, Vol. 30.) Pp. viii + 510 + 65 plates. (Philadelphia: American Philosophical Society; London: Oxford University Press, 1937.) 22*s*. 6*d*. net.

GREAT strides have been made in recent years in the field of mammalian palæontology, and the evolution of some at least of the orders of mammals are now set out with a great wealth of detail. Osborn's great monograph of the Titanotheres, for example, or his history of the Proboscidea, of which the first volume has recently appeared, show in a very striking manner not only how great is the amount of material on which to work, but also how complex has been the course of evolution of the mammalian orders. These works, however, and others similar, do not, as a rule, begin their story before the Eocene, by which time the orders dealt with had become well established. Their 'pre-history' and inter-relationships, therefore, are not elucidated.

Simpson's classical monographs on the Mesozoic mammals have given us all the information that is as yet possible as to the dawn of mammals from their reptilian ancestors and of their evolution up to the, as yet little known, Cretaceous period; but thereafter until the Lower Eocene, by which time the mammalian orders had for the most part become defined, there has been a serious gap in our knowledge. At one time, this hiatus seems to have been considered as a comparatively small affair termed merely the 'Basal Eocene'. Now, as the Palæocene, it takes rank as one of the major divisions of the Tertiary, equivalent in importance with the Eocene, Oligocene or other of the periods.

The late Dr. W. D. Matthew's monograph on the Palæocene faunas of the San Juan Basin of New Mexico, as a résumé of previous information and a great addition of new, is a most important contribution to the early history of mammalian evolution. The San Juan formations yield a series of deposits ranging from the Upper Cretaceous, separated by an unconformity from the Puerco, Torrejon and Tiffany beds of the Lower, Middle and Upper Palæocene respectively, to the Wasatch beds of the Lower Eocene. This covers a great range in time, and the faunal list of mammals (a smaller list of reptiles is also included) is impressive with its forty, or more, genera distributed among fourteen families and no less than seven orders. A few of these, such as the Multituberculates, are remnants of the earlier Mesozoic radiation that were dying out, but among the Creodonta, Condylarthra and Insectivora may be sought the foundation members of our modern mammals, and by implication some picture may be made out of the centralized common ancestors all of which must have flourished during the little-known Cretaceous period. A diagram is here reproduced (Fig. 1) which shows, in a summary form, the author's conclusions as to the relationship of the mammals of the period and, incidentally, where our knowledge is still lacking. The bulk of the volume, after a short explanatory introduction, is devoted to a systematic and descriptive revision of the Palæocene mammals of New Mexico, and is followed by some general observations and conclusions. The descriptions of the various species, the eighty text figures and sixty-four quarto plates leave nothing to be desired.

No one familiar with Matthew's numerous other contributions would expect the general observations and the discussion which conclude the work to be other than stimulating. The origin and evolution of the tritubercular tooth, the characters of the feet and limbs from their primary types and of the skull and skeleton generally, all receive illuminating treatment, as also does the account of the correlation of the different faunas and the origin and evolution of the tertiary mammals as a whole. The last word on this great assembly of early mammals has yet to be said. Many species are still known only from fragments, and the patient collecting which began under Cope so far back as 1880 must still go on in order to fill up the gaps in our knowledge. All future workers in this field will turn to the present volume as a classic for guidance and inspiration.

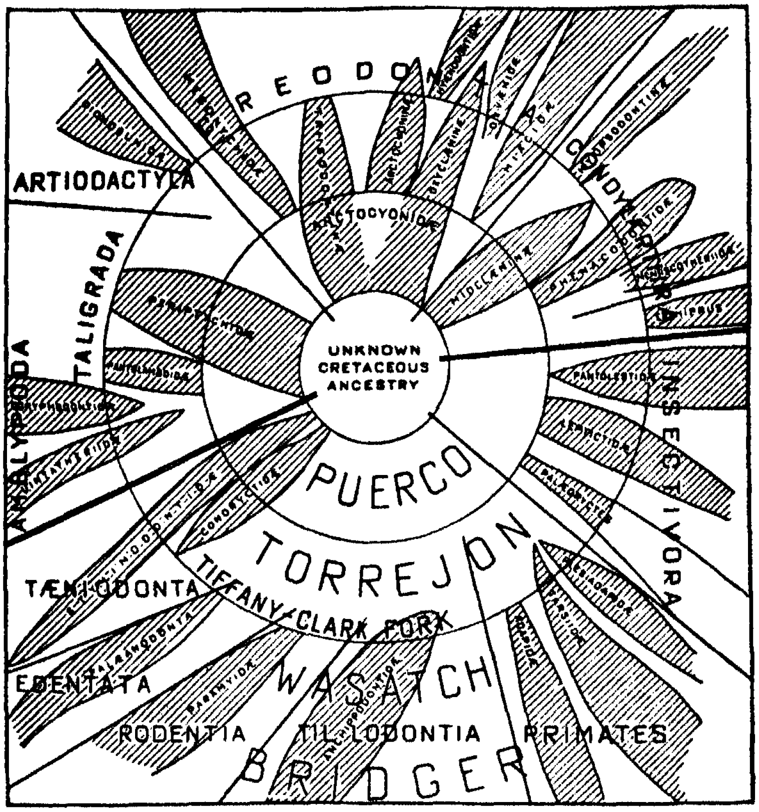

Fig. 1.

RELATIONSHIP OF THE MAMMALS OF THE CRETACEOUS. FROM MATTHEW'S "PALEOCENE FAUNAS OF THE SAN JUAN BASIN, NEW MEXICO".

Although the editors (Prof. W. K. Gregory, Dr. Granger and Dr. Colbert with the assistance of Dr. Simpson) state that their work has been limited to an "addition of references", the thanks of all workers in mammalian palæontology are due to them for the labour of seeing the volume through the press so efficiently, and to the Trustees of the American Museum and to the American Philosophical Society of Philadelphia for their public spirit in making possible the publication of so useful and important a work.

C. F. C.

Adsorption Columns

Die Chromatographische Adsorptionsmethode: Grundlagen, Methodik, Anwendungen. Von Prof. Dr. L. Zechmeister und Dr. L. v. Cholnoky. Pp. xi+231. (Wien: Julius Springer, 1937.) 14.40 gold marks.

WHEN Tswett, to whom the authors of this book refer as "genialer russischer Botaniker", first used the chromatographic absorption method for the separation of chlorophyll *a* from chlorophyll *b*, he was probably quite conscious of having introduced at least a novel application of physical phenomena that themselves may have been already known to many. He can, however, have had no conception of the extraordinary variety of compounds to the separation of which the method was to be applied in the following thirty years; indeed the very existence of these compounds was in many instances unknown in Tswett's time.

The adsorption of a solute upon a solid insoluble in the solvent of the solution had been recorded many times, and even used as a means of separation, when Tswett conceived the idea of making the solution flow in one direction—vertically downwards—through a column of the adsorbent, so that the adsorbed material might afterwards be desorbed, or 'eluted', by the same or some other more suitable solvent.

The solutes then arrange themselves in a series of bands, the distance of which from the top of the column is primarily determined by the 'adsorption potential' of the solute, the less easily adsorbed being found in the lower band. By the subsequent use of other suitable solvents, the bands may be 'developed', that is, the distance between them is increased, so that the column can then be cut, and the bands separated mechanically from each other. Alternatively, the principle of the 'liquid chromatogram' may be employed; in this application, the undeveloped bands are washed out *seriatim* into different containers, by using an eluent with solvent properties suitably related to the adsorption potentials of the materials in the various bands.

It is of more than historical interest to note that one of Tswett's original columns consisted of sucrose, his solvent being a suitable organic liquid. We have come to-day to think of adsorbents so much in terms of acid clays, alumina, calcium carbonate or hydroxide, and so on, that we are apt to forget the relativity of adsorbent, solvent and adsorbate.

The first, or general part of this book is divided into two chapters, on fundamental principles and methods respectively. The special, or second, part is divided into three chapters, covering in turn natural colouring matters (including chlorophyll, prophyrins, carotenoids, naphthaquinone and anthraquinone dyes, flavones, pterines, anthocyanins, etc.), synthetic or artificial colouring matters, and various colourless or slightly coloured substances—among which occur terpenes, glycosides and aglycones, alkaloids, vitamins, enzymes, and so on.

The information given about the application of chromatographic methods to such diverse substances is remarkably complete for a volume with only 190 pages of text (the rest of the book consists of a table of contents, some plates of photographic records, a bibliography with nearly 400 references, and both author and subject indexes). Moreover, the value of the book is further enhanced by some unusual tables, "thrown in", as it were, with a pound of chromatography. The complete list of carotenoids of known constitution, with their formulæ, in order of their adsorption-potentials, and, later, the list of all known carotenoids and derivatives, with their sources, show where the authors' personal special interests have lain, but there are no other signs of predilection in the book.

Since chromatography is essentially a method of *analysis*, it is rather surprising that analytical chemists have so far made very little use of it. In this book, the authors have only been able to cite a few isolated applications, as for example to the detection of falsification in the colour of wines, and even here the method is qualitative only, or at best semi-quantitative. When, however, the analyst has to separate two solid substances the chemical constitutions of which are sufficiently close to make separation by precipitation or crystallization either incomplete or impossible, precision chromatography would seem to offer a possible technique, provided the substances are reasonably stable in solutions of appropriate strength.

This admirable and comprehensive monograph by Prof. Zechmeister and Dr. v. Cholnoky, of the University of Pecs, both well-known exponents of chromatography, to the literature of which they have themselves made valuable contributions, is about as good as such a book can be. Clearly produced, logically arranged, painstaking in its presentation of detail, exhaustive in its citation of examples—it is the complete handbook for the practising or would-be chromatographer. An English edition is urgently needed.

A. L. BACHARACH.

Reports of the Progress of Applied Chemistry

Vol. 21, 1936. Pp. 875. (London: Society of Chemical Industry, 1937.)

THIS volume appears so punctually year by year soon after the end of the period surveyed, and is so consistently full of well-digested reports, that every English-reading chemist must now be fully aware of its value; indeed, with many its appearance is reckoned an event. One reason for the welcome which always attends its arrival is evident; for after twelve months' struggle to keep one's head above the flood of chemical literature in which one is even mildly interested, a raft on which one may float awhile and contemplate the scenery is not to be despised. These surveys of progress in the several branches of technological chemistry appeal also to those who, having sufficient chemistry to follow their purport, are however not engaged in the work they describe, and perhaps would not regard themselves as chemists at all.

Among the new contributors are Mr. M. B. Donald (general, plant, and machinery), Dr. J. Grant (pulp and paper), and Dr. J. A. Sugden (refractories, ceramics, and cements), while Prof. W. E. S. Turner (glass) and Dr. D. F. Twiss (rubber) are old friends who have returned. This year the biennial report on explosives is included. There are 26 sections in all, with general name and subject indexes, and of course the information presented is lavishly documented, references being given both to original sources and to abstracts. It would probably be fair to describe the Report as a whole as "better than ever"; which means that it reflects steady progress both in technical achievement and in presentation. A. A. E.

Polychromatic Plates for Color Sense Examination

By Dr. E. B. Rabkin. Pp. 40 + xx plates. (Kharkov: State Medical Publishing Board, 1936.) 30 roubles.

THIS series of tests for colour defect issues from the laboratory for colour vision of the Hirshman Memorial Ukrainian Central Ophthalmic Institute, of which Dr. Rabkin is the director. The tests are composed of coloured figures on coloured backgrounds, such as are found in the Stilling and the Ishihara tests. A number of the plates contain also 'hidden' figures, which are visible only to the dichromate. Triangles, circles and squares appear on some plates instead of figures, and so can be used for testing children and illiterates. A diagnosis can be made from the tables of dichromasy in general, and of protanopia, deuteranopia, and tritanopia in particular. The author claims, too, from the tests that "the simpler forms of anomalous trichromasy" can also be detected. Plates are added to detect simulation.

The series itself has been tested out in the Experimental Ophthalmic Clinic of the Institute of Experimental Medicine at Kharkov, and has proved successful. It seems, if one can judge from a preliminary survey, to give satisfactory results, and can be recommended. The book contains detailed and clear instructions in both Russian and English, although the English translation contains some curious phrases and sentences, and the spelling is not always of the best. MARY COLLINS.

Organic Syntheses:

an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. L. F. Fieser, Editor-in-Chief. Vol. 17. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 8s. 6d. net.

PRODUCED on the plan now familiar to organic chemists and biochemists, the latest addition to this series contains details of thirty preparations. Among the open-chain substances are γ-aminobutyric acid, made by a modification of Gabriel's method; ε-aminocaproic acid, prepared from 2-ketohexamethylenimine; and 1,3-butadiene. It is stated that between 25 gm. and 30 gm. per hour of crude butadiene may be produced by passing the vapour of *cyclo*hexene over a cracking element, in an ingenious apparatus which is here fully described with the aid of a diagram.

Of interest in carbohydrate chemistry is the account of the acetolysis of cotton, and of the hydrolysis of the resulting α-cellobiose octa-acetate according to Zemplén's method. Biochemists will also welcome the details given for the hydrogenation of cholesterol to dihydrocholesterol (β-cholestanol) and the oxidation of this to cholestanone. Under the heading of 2-carbethoxy*cyclo*pentanone (prepared from ethyl adipate) may be found a description of the useful Hershberg stirrer for pasty mixtures. Finally, the stereochemist is catered for in the precise directions given for the synthesis and complete optical resolution of that useful stereochemical agent, α-phenylethylamine. J. R.

Mechanistic Biology and Animal Behaviour

By Theodore H. Savory. Pp. xv + 182. (London: Watts and Co., 1936.) 7s. 6d. net.

MR. SAVORY'S book gives an eminently lucid and readable description of tropistic behaviour in some invertebrate organisms. The book, however, is largely devoted to an unconvincing exposition of certain well-worn theoretical issues. Mr. Savory defines his aim as the purely objective description of behaviour, which for the purposes of deterministic analysis he regards as the "visible response of an animal to some kind of stimulation which originates most frequently from a disturbance of its environment". He strays, however, from the logical demands of his definition, which is generally accepted by scientific students of behaviour, when he leaves the field of straightforward description. Thus, when he departs from the world of invertebrate organisms with which he is familiar, and discusses mammalian forms such as dogs, he accepts *a priori* concepts such as 'mind' and 'intelligent' as opposed to 'sub-intelligent' behaviour, and fails to realize that to the student of behaviour these concepts are somewhat empty. It is clearly illogical for the experimental investigator to ask whether spiders that lurk under stones have mind and self-awareness, and then to answer 'no' merely because the particular tropisms which drive spiders under stones have been defined.

The book closes with an uncritical statement about the influence of acquired habits on the course of arachnid evolution.

Measurement of Submarine Daylight

By Dr. H. H. Poole

SUBMARINE measurements of solar radiation are of interest to oceanographers, who are concerned with such problems as the rate of rise of temperature of the water, the rate of photosynthesis, the movements of zooplankton, or the depth limits of daylight vision for fish. They also enable us to measure the opacity of the water, which, being an index of the amount of matter in suspension, may give valuable evidence as to its previous history, and is likely to be of importance in connexion with the nutrition and migration of fish.

A thermopile with suitable colour filters has been used by Birge and Juday to measure the total radiation, and that in different spectral bands, at various depths in American lakes, but for work at sea the measurement of the very small potential differences presents difficulties. As the spectral sensitivity range of the selenium rectifier photoelectric cell covers the band showing appreciable penetration through sea-water, it appears to be the most convenient instrument at present available for submarine work.

This cell has a range of sensitivity extending somewhat beyond both ends of the visible spectrum, with a maximum about 595 mμ (that of the eye being about 555 mμ). It appears to be permanent, apart from temporary fatigue or temperature effects, which may amount to a few per cent in strong illumination. For small illuminations the current generated is proportional to the light, but in strong light the ratio current/illumination falls appreciably, and the necessary corrections must be found if the cell is to be used to measure intense illumination. The fall in this ratio with increasing illumination becomes much more important with a high-resistance external circuit, so that a low-resistance measuring instrument is always desirable, and sometimes essential.

The Weston selenium cell which has been used by Utterback, and also by Atkins and Poole, gives, when exposed under a sheet of opal-flashed diffusing glass, a current of one microampere for about 20 lux. With a 10 ohm galvanometer the sensitivity would fall to about 1 μamp. per 25 lux in full sunlight. The Lange selenium cell used by Pettersson is more sensitive, giving 1 μamp. for about 5 lux in weak light. The fall in sensitivity in strong light is, however, so great that the cell must be protected by a suitable reducing screen when used to measure bright daylight. This screen must be removed for weak light readings.

The choice of a suitable instrument to measure the current presents certain difficulties, as the claims of current sensitivity, lowness of resistance, quickness of reading, and insensitivity to the motion of the ship, are not easily reconciled. Utterback has used a special marine galvanometer, Atkins and Poole a modified form of their potentiometer method previously used with emission cells, adapted so as to include the principle and advantages of the zero-resistance circuit devised by Campbell and Freeth, while Pettersson, aided by the greater sensitiveness of his Lange cells and the comparative steadiness of his ship, has found simpler pointer and light-spot galvanometers satisfactory in his work.

The cell mounted behind a strong glass window in a watertight case is lowered to any required depth by means of a wire and a spar projecting over the ship's stern, thus minimizing the shading effect of the ship and the vertical movements due to rolling. Utterback uses a case large enough to contain a set of colour filters, which can be interchanged by an electromagnetic device. This is a great advantage, but the size and complication of the apparatus are drawbacks, and most workers have contented themselves with the use of external filters laid on the window, which is generally horizontal, and changed by hauling the photometer on board. Above the colour filter is placed the opal diffusing glass, the use of which is rendered necessary by the varying obliquity of the illumination to be measured. The transmission of the colour filter is not affected by such variations in obliquity, as the filter is below the opal, and submarine light the obliquity of which is greater than 48°, and which would be prevented by internal reflection from reaching the cell if the diffusing glass were absent, can reach the internal diffusing layer in the opal glass and be duly measured.

The use of colour filters to limit the range of sensitivity is rendered necessary by the differential absorption of the water, which entirely alters the average composition of the radiation with depth, and thus alters also the sensitivity of the cell, so that it is very difficult to interpret the submarine readings of a selenium cell without filter. The following Jena glass filters, each 2 mm. thick, seem to be suitable for general work: red, 720–600 mμ, *RG* 1; green, 600–480 mμ, *VG* 9; blue, 480–360 mμ, *BG* 12. The limits are only approximate and are affected by the falling sensitivity of the cell towards both ends of the spectrum.

The variations in the surface light must be observed by a second cell exposed under a similar filter and opal glass in a position on deck as free as possible from shading by spars and rigging. The photometer is directly compared side by side with the submarine photometer, and the simplest means of expressing the submarine illumination is as a percentage of the surface light in the same spectral band at the same instant.

It is more difficult to express the submarine illumination in definite units. The selenium cell, being more sensitive than the eye to both ends of the visible spectrum, does not differ very greatly from the latter in its estimate of common illuminations of different predominant colours. Thus, if it is standardized with a filament lamp at a colour temperature 2,360° K., it appears to under-rate average sunlight by some 10–20 per cent. The use of a higher temperature source for standardization reduces this discrepancy, and some workers have used for this purpose the Davis-Gibson colour filter, reproducing with fair accuracy average noon sunlight. We can then express in 'lux' the reading of a cell exposed without colour filter in air, without introducing any serious error, by the use of a term which is strictly only applicable to visual measurements. With colour filters, however, or under water, which acts as a colour filter, this quasi-visual scale becomes meaningless and misleading.

The ideal procedure is evidently to express the results in terms of the radiant power in the different spectral bands, say, in microwatts per square centimetre. Clarke has used this method of presentation for his work with emission cells in the western Atlantic, and Atkins and Poole have also standardized some of their cells in power units. The lowness of the colour temperature of all ordinary sources, however, limits the accuracy of the standardization, and has led Ångström to suggest a method of standardization by means of sunlight which may prove to be the best available.

There is general agreement between the results obtained by workers on both sides of the Atlantic and in the north-eastern Pacific, the large variations in the opacity of the water found by all being obviously due to local conditions. The clearest water so far recorded was found by Clarke in the Sargasso Sea. Working down to 180 metres, he found a value as low as 0·03 for the extinction coefficient of blue light. This means that the fall in the illumination on a horizontal surface was only 3 per cent per metre, the light falling to one tenth of its value at about 80 m. depth. In this water both green and violet light gave coefficients close to 0·05, while for the light passing through an *RG* 1 filter Clarke found a coefficient 0·08 for depth range 20–80 m. This is an extraordinarily low coefficient for 'red' light, and may possibly be due to the action of the overlying water layers (in which the absorption was much more rapid) in removing all wave-lengths much longer than 600 mμ, leaving only a very narrow spectral band of orange-red.

In coastal waters higher coefficients are always found, the absorption of the shorter waves increasing more rapidly than that of the longer. Thus, in both the English Channel and in the north Pacific the coefficient for blue and green is generally about the same, and not far from 0·1 at a distance of 20 miles off shore, the illumination falling to one tenth of its value every 23 m., the corresponding average figures for red being 0·4 and 5·75 m. Closer inshore, green becomes the most penetrating colour, the coefficients for all colours rising with the increased turbidity of the water.

In considering the variation of opacity with depth, one must remember the 'hardening' effect of absorption on polychromatic radiation, although this effect is greatly reduced by the use of colour filters. It is still probably of importance with the *RG* 1 red filter, as the longer wave-lengths of the range covered are absorbed even more rapidly than those near the 600 mμ limit. The effect is probably of much less importance with the green and blue filters.

Real variations of opacity with depth are often met with. As a general rule, ocean water becomes clearer below the surface layers, but inshore waters often show irregular variations, which may be very useful for studying their stratification. For exploring these rapid changes of opacity the use of Pettersson's transparency meter, which measures the intensity of a beam of artificial light reflected through 2 metres of water, is almost certainly preferable to the deduction of the opacity from the ratio of the daylight illuminations at two different depths, but it is not easy to correlate the results obtained by the two methods.

It is evidently highly desirable that oceanographers should be provided with a standardized method suitable for routine measurements of submarine daylight, and with this end in view the International Council for the Exploration of the Sea arranged for a special meeting of workers in the subject at the 1936 meeting at Copenhagen. It would seem that some further experience of the available cells and modes of measurement is desirable before any definite specification of apparatus and methods can be drawn up. In the meantime, a fairly full review by different authors of the work done up to date, with extensive bibliographies, will be found in the report of the 1936 meeting of the Council, and a report of the special sub-committee then appointed to consider the question is being presented at the meeting this month in Copenhagen.

Greenland Culture: (1) The Norsemen*

ACCOUNTS of the ill-fated Norse settlements in Greenland in medieval times, such as that recently published by Dr. Nörlund (see NATURE, 133, 949) have been based hitherto on the evidence afforded by the eastern settlement (now the district of Julianehaab), in which, thanks to the researches of the last fifty years, most problems of topography have been solved and the cultural history elucidated in no little detail by archæological discovery. Of the western settlement, however, in the Godthaab District little was known either from literary sources or from archæological investigation before the expeditions of the Commission for Scientific Research in Greenland, of which the results have been described recently by Dr. Aage Roussell. It was inferred, however, with reasonable certainty that the place now known as Kilaussarfik, visited by Daniel Brunn in 1904 and the site of Dr. Roussell's excavations in 1930, 1932 and 1934, was to be identified with Sandnes, and Ameralik Fjord with the ancient Lysufjördr, not least, perhaps, on account of the rarity of such a sandy formation on the rock-bound coast of Greenland. As, however, the area is being submerged rapidly, and the coast-line has changed considerably since the Middle Ages, this is by no means indisputable evidence.

Historical records relating to the west settlement are few. Apparently it was established simultaneously with, or just after, the east settlement, shortly before A.D. 1000. The Saga of Eirik the Red mentions a serious epidemic there in the first decade of the eleventh century. By the middle of the fourteenth century, Skraellings (Eskimo) had occupied all the west settlement, "so there are many horses, goats, cattle and sheep run wild, and no people, neither Christian nor heathen". All archæological finds, in default of evidence to the contrary, are to be regarded as prior to 1365.

In addition to the church at Sandnes and the neighbouring farm, of which the name is unknown, Dr. Roussell excavated in 1934 two other farm sites on the opposite side of the fjord. Of these, Umiviarssuk alone has been described, the important results obtained at Ujaragssuit still awaiting publication.

The site investigated at Sandnes included church and churchyard, house, smithy, and two large stable complexes. The store-house—invariably part of a Norse farm—presumably stood on the fjord bank, but, if so, it had been washed away. The central part of the farm had been built on sloping ground and a constant movement of soil has covered the whole site with midden, making it impossible to arrive at any accurate idea of stratification. At times, objects were found above others which obviously were of later date.

Since the date of Daniel Brunn's visit, the church ruins at Sandnes have suffered much damage owing to submergence and climatic conditions. Consequently it was found impossible to determine the extent of the churchyard; but accumulations of stones on the fjord beach indicate the probable limit of interment. Only in the westerly part of the churchyard were interments uncovered.

No less than forty-two burials were found huddled in a confined space. They lay under the midden in coarse yellow gravel and only just below the original surface. Owing to crowding, older graves frequently had been disturbed in digging new, and half skeletons, or skeletons with lower limbs hewn off, were found. As is usual in Christian burials, the body lay on the back with the head towards the west and arms crossed on the breast. One interment in the south end of the area contained two adults, presumably man and wife, with the skeleton of a child lying on each. Alongside and evidently buried at the same time lay a fifth skeleton, not fully grown, and beside the skeletons was a small crudely fashioned wooden cross, the only piece of grave furniture found *in situ*. It may be presumed that these five burials were the result of an epidemic, such as is mentioned in the sagas of Eirik and Thorfinn.

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* Researches into Norse Culture in Greenland—Sandnes and the Neighbouring Farms. By Aage Roussell. Appendix: Greenland Runic Inscriptions, 4. (*Meddelelser om Grønland, Bind 88, Nr. 2.*) Pp. 232+6 plates. 11.00 kr.

Researches into Norse Culture in Greenland—Animal Remains from the West Settlement in Greenland, with Special Reference to Livestock. By Magnus Degerbøl. (Meddelelser om Grønland, Bind 88, Nr. 3.) Pp. 55+1 plate. 2.50 kr.

Researches into Norse Culture in Greenland—Evidence of Iron Extraction at Sandnes, in Greenland's West Settlement. By Niels Nielsen. (Meddelelser om Grønland, Bind 88, Nr. 4). Pp. 14+1 plate. 0.75 kr.

(København: C. A. Reitzels Forlag, 1936.)

What was from the artistic point of view the most important find made in the course of this investigation may be mentioned here, as it came from the churchyard, though not found *in situ*. This was a carved slab of wood of unknown use, though it may have been part of the cover of a pyx. The wood has been identified as fir and driftwood. On it is carved in relief a representation of the Crucifixion showing the figures of the Virgin Mary and St. John in a pose and with attributes characteristic of medieval Scandinavian art. The figures are Gothic; but the ornament is still Romanesque. Though unquestionably of Scandinavian origin, it is not of local workmanship, and may derive from thirteenth century Iceland, or possibly Norway. Examples of local workmanship are to be seen in representations of the Crucifixion, rough in character, in which the figures in metal had been nailed on in a technique familiar in examples known from Iceland.

The important site at Umiviarssuk afforded fuller detail than Sandnes of the cultural level of the Norse farm, though here in the excavation of the house itself the work of clearing the plan was complicated by the fact that a later building overlay one and possibly two earlier structures. The farm buildings of the west settlement were substantial erections of stone. It was possible to ascertain the disposition of living rooms, sleeping rooms, hearths, etc. Immediately behind the farm-buildings at Sandnes was a series, or rather two complexes, of outbuildings for cattle, sheep, pigs, and goats and the farm workshop. In one of these, stone divisions provided 'boxes' for tethering the cattle; while in another, small finds suggested that one or more of the humbler female servants had slept here. Sandnes also had a small forge, which afforded samples of the iron used in working.

An interesting building at Umiviarssuk was a bath house, which, though the bath is frequently mentioned in the records, is the first to be found in Greenland. It is of the usual vapour-bath type, with furnace and shelves, on which the bathers reclined. It was apart from the house, and if the bathers did not follow the modern practice in high latitudes of a cold plunge in the snow, they at least had to pass through the cold air in returning to the house. Another find on this site of an unusual character was a movable bed. Although there are references to such beds in the sagas, its use had died out in the Middle Ages in favour of the bed fixed to the wall. It was not reintroduced until the sixteenth century; but its survival in Greenland points to the backward state of the community.

The most noteworthy feature in the work of Dr. Roussell's expeditions is the very large number of small objects found, which has thrown a flood of fresh light on Norse culture in Greenland. The character of the soil enabled the preservation of a number of objects, especially in wood, bone and baleen, which had perished on sites previously excavated. Nearly twelve hundred objects in all were found. The state of preservation may be judged from the fact that in some the original colour of the wood can still be discerned. Among the small objects, one of the most interesting is a toy model of a boat, which reproduces its original in accurate detail. Comparison with earlier known examples of the Norse boat dating from the sixth century shows that the form of ship virtually suffered no change over a period of six hundred years.

Other finds included tools, weapons, implements, household utensils, clothes, games such as chess, dice and draughts, toys and objects of unknown use. Trinkets were rare. In addition to the objects of art already mentioned—the wood-carvings of a religious character—there was a number of small objects in bone, wood and ivory, including two lively representations of animals, a bear and a walrus, and two of the human face, of which one in walrus ivory with its wide mouth, long upper lip, heavy jaw and coarse skin gives anything but a favourable impression of the physical type of some, at least, of the Greenlanders.

The animal bones indicate that the inhabitants of the western settlement kept cows, sheep, horses, pigs and dogs and hunted the same wild animals, reindeer, seals, whales, arctic foxes, arctic hares, and polar bears, as the settlers on the east coast. For the first time, the bones of the dog are available for comparison with representations of the animal of this period. The surprising feature is the length and slenderness of the legs, which suggest a breed of something of the greyhound type

Although there is evidence to suggest that the Norsemen had extracted iron in Greenland, the number of iron objects found is small. The material from Sandnes is the most considerable find that has been made, consisting of fifty lumps of slag and a small piece of hammered iron of prismatic form. The material has been subjected to detailed examination and is very heterogeneous. Two types of iron are present, which agrees with what is known of Middle Age practice of producing iron in hearth pits, and shows the difficulty experienced by the ancients in producing iron capable of hardening. While some samples consist of a soft iron, practically devoid of carbon, others are a medium hard carbon steel. The evidence from Sandnes is taken to show that the Norsemen did produce a form of steel, but that their methods of working and exposure to the air reduced the product finally to nothing but a soft iron.

Belgian Stratosphere Balloon Experiment

THE most difficult part of the planning of a large stratospheric balloon is how to control the rate of descent in the upper atmosphere. If a balloon is large enough to reach about 19 miles (1/100 atmosphere) the hydrogen must contract during the descent, and the bag will be only 10 per cent filled at 10 miles: it is then difficult to avoid a dangerous flapping of the bag, except by controlling the speed by a continuous dropping of ballast; incidentally, the weight of that extra ballast would have reduced the maximum altitude reached.

If air is allowed to flow into the bag through the appendix, the flapping danger disappears; but, during the daytime, the sun heating the air in the bag causes sufficient expansion to stop the descent, even if all the hydrogen is removed. A better solution seems to be to admit air, but to remove it automatically as soon as it is warmed. That method was tested by Max Cosyns during his 1934 ascent, by replacing the valve of his balloon by a collapsible fabric tube, about six feet in diameter, distended by wooden rings, and stretching down the axis of the balloon (Fig. 1*a*). If the opening of that tube is set near the limit between the hydrogen and the air, the air flows continuously upwards as soon as it is warmed. The method worked perfectly well on the *F.N.R.S.*, the diameter of which was 100 ft.

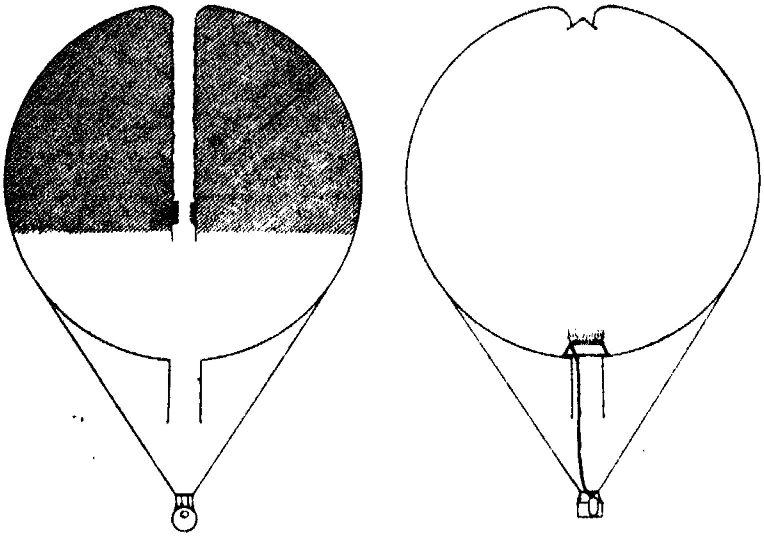

Fig. 1.

For a 200-ft. balloon, the use of the same principle would require a tube 17 ft. in diameter, twice as long as before, and about twenty times as heavy, which weight is prohibitive. To calculate the minimum diameter admissible, it is necessary to know exactly the amount of heating inside the bag due to the sun. As it depends on the thermal air eddies inside and outside the bag, it is useless to try to determine that quantity by extrapolation from experiments made on models a few feet in diameter. In order to measure the heat transfer on a model as large as possible, an experimental ascent was planned by A. Piccard and M. Cosyns with the old *F.N.R.S.* filled with hot air. At an altitude of about 5 miles, the heating power of the sun is not very far from its maximum value, and the temperature is about the same as at 20 miles. Knowing the total weight of the balloon, and the amount of supplementary heat necessary to balance it, the temperature rise due to the sun could be deduced with a precision of a few tenths of a degree.

The supplementary calories were to be furnished by a burner placed inside the bag (Fig. 1*b*) using pure propane, 150 lb. of which was carried in the liquid state in an aluminium bottle weighing 60 lb. The burner was able to burn 2 lb. of propane each minute, with good efficiency, and twice as much in emergency (the lifting power given by a pound of propane is about 160 lb.). It was composed by 42 batwing-burners placed on a ring 7 ft. in diameter, to ensure a good mixture of hot and cold air, and to prevent a flow of gases at too high a temperature from reaching the top of the balloon. The flow of propane was measured by a diaphragm 'dèprimomètre,' and by weighing at intervals the aluminium bottle.

Unfortunately, just before starting on May 25, the twisting of some ropes obliged the land crew to release some of the slings, and an unforeseen squall shook violently the bottom of the balloon, upturning the burner before it was possible to shut off the flame; the bag of the balloon was destroyed by fire in about a minute. The material loss was not important, as the *F.N.R.S.* was getting old and was about to be dismantled.

M. COSYNS.

News and Views

Prof. F. W. Thomas, C.I.E.

PROF. F. W. THOMAS of Oxford has been elected president of the ninth All-India Oriental Conference, which will be held at Trivandrum in December next. He has also been elected a corresponding fellow of the Philosophical and Historical Section of the Prussian Academy of Sciences. Prof. Thomas, who has been Boden professor of Sanskrit in the University of Oxford since 1927, and is a fellow of Balliol College, was librarian of the India Office from 1903 until 1927, and was awarded the C.I.E. in the honours list of 1928 on his retirement from that office. He is chairman of the Section of Oriental Studies of the British Academy, and represents that body as a governor of the School of Oriental Studies of the University of London. He is also reader in Tibetan and lecturer in comparative philology in the University of London. Prof. Thomas has long been known as one of the foremost scholars in the classical languages of the East, in which he has acted as examiner not only in all the universities in Great Britain which offer a course in those languages, but also in the principal universities of India. His outstanding knowledge of Buddhist art and literature received the signal recognition of the award of a medal in 1934 at the Tokyo celebration of the two thousandth anniversary of the birth of Buddha. He is the author of a large number of publications on the philology and literature of Sanskrit, Pali and other oriental languages, as well as on the art and literature of Buddhism.

Prof. Walter G. Cady

THE Council of the Physical Society has awarded the fourteenth Duddell Medal to Walter G. Cady, professor of physics at the Wesleyan University, Middletown, Connecticut, U.S.A., for his work on piezo-electric resonators and oscillators as standards of frequency. Prof. Cady's pioneer work on the subject was published in 1922 (*Proc. Inst. Radio Eng.*, **10**, 83) and the value of the device may be judged from the fact that it stimulated research work on the subject in all parts of the world, more than a thousand papers having been published on the properties of piezo-electric crystals since the appearance of Cady's first paper. Of course, these are not all due to Cady's work, for Langevin had previously used piezo-electric crystals as vibrators for underwater signalling, but Cady's particular contribution—the use of the quartz resonator as a standard of time or frequency—has quite obviously inspired most of the work. The use of these resonators as standard vibrators has made it possible to measure frequency and intervals of time with an accuracy not previously attained. It is scarcely necessary to emphasize the importance to physics of increased accuracy in such fundamental measurements. Among the applications which have already been made the following may be mentioned: (1) The quartz-clock now used as standard in some observatories. It is in some respects superior to the pendulum clocks, and in any event is a most valuable supplement to them. (2) The measurement and control of the frequency of alternating currents in connexion with measurements of dielectric constant, 'absolute' electrical measurements, etc. (3) The measurement of the velocity of ultrasonic sound waves. Duddell, who was responsible for so much elegant instrumental work, would have been the first to recognize the beauty of Prof. Cady's device, and it will be a source of great satisfaction to all scientific workers to know that the value of Prof. Cady's work has been recognized in such an appropriate manner.

Centenary of the University of Durham

THE University of Durham, though now well over a hundred years old, has just celebrated its centenary. It was originally intended to hold the celebrations five years ago, since the Act of Parliament which provided for the foundation was passed in 1832. Owing to the economic depression, however, it was felt inappropriate to enter into rejoicings under the cloud of industrial stagnation which, in 1932, was locally responsible for widespread distress. The present year has a historical claim to recognition, apart from the atmosphere of returning prosperity, for it was in 1837 that the University was granted its charter by William IV. Moreover, as a result of the recent Royal Commission, the University is about to enter upon a new phase of its history. The main celebrations were held at Durham on July 1, and were attended by delegates from all the other Universities of the British Isles and from several in Canada, Australia, New Zealand, South Africa, India and the United States. Learned societies were represented by, among others, Sir William Bragg, Lord Dawson of Penn, Dr. H. Spencer Jones, Prof. F. G. Donnan and Prof. O. T. Jones. After a morning visit to the Colleges, including the Castle, a centenary service was held in the Cathedral, where the preacher was the Bishop of Durham. The keynote of Dr. Henson's discourse was that universities are the "watchdogs of human liberty". "The new universities," he said, "were born and cradled in an atmosphere of freedom. They surely must stand in the forefront of the champions of academic liberty against the aggressions of the totalitarian State or the subtler assaults of racial fanaticism". After the service, the delegates were entertained to luncheon, some in the Great Hall of the Castle (by the University), and others at the Town Hall (by Lord Londonderry, Chancellor of the University and Mayor of Durham).

IN the afternoon, a Centenary Convocation was staged in the picturesque surroundings of the Castle quadrangle. Each delegate was introduced to the

Chancellor, to whom addresses of congratulation were presented. The Chancellor then conferred the honorary degree of D.C.L. upon nine distinguished men: Dr. C. A. Allington, Dean of Durham; Prof. P. P. Bedson, emeritus professor of chemistry; Lord Cadman, an old graduate of the University; the Hon. J. A. Hanan, chancellor of the University of New Zealand; Sir John Jarvis, the promoter of many schemes to help the distressed area of Jarrow; the Rev. S. R. P. Moulsdale, until recently principal of St. Chad's College; Mr. Tracy Philipps, explorer and war correspondent; Sir Cuthbert Wallace, president of the Royal College of Surgeons; and Mr. G. H. A. Wilson, master of Clare College and vice-chancellor of the University of Cambridge. Convocation was followed by a garden party in the adjoining Fellows' Garden. Later, the delegates were entertained to a banquet in the Great Hall, after which they were received by the Council of the Durham Colleges.

It is interesting to record that so early as 1650 a petition to Parliament that a college be established at Durham was approved by Cromwell. When university powers were applied for, however, the proposal was thought to be prejudicial to the older universities and the Great Seal was withheld. No more was heard of a northern university until a draft scheme was drawn up in 1831. The necessary Act was passed in 1832, and the first students came into residence during the following year. Among the first members of staff was J. F. W. Johnstone, lecturer in chemistry and mineralogy. About the same time (1834) the Newcastle-upon-Tyne College of Medicine originated, though it did not become connected with the University of Durham until 1852. Durham College of Physical Science was founded in Newcastle in 1871. It had then four professors—mathematics, physics, chemistry and geology—but by the time its name was changed to Armstrong College, in 1904, a very wide range of university subjects had long been incorporated. Now, both the College of Medicine and Armstrong College are about to be united, under the revised constitution of the University, as a new corporate body to be known henceforth as King's College. At Durham itself, science seems to have lapsed after the death of Johnstone in 1855. Since 1924, however, when the first block of the present Science Laboratories was opened, several very flourishing schools have developed. Under the new regime, the University of Durham (consisting of the Durham Colleges, together with King's College, Newcastle-upon-Tyne) enters the most promising period of its history, with every prospect of expanding achievement and prosperity.

The World's Air Altitude Record

The world's air altitude record was regained for Great Britain by the Royal Air Force on June 30, by a flight to an altitude of 53,937 feet (more than ten miles). The previous record of 51,362 feet was held by Lieut.-Colonel Mario Pezzi for Italy, who beat the then British record of 49,944 feet last autumn. The flight was made from the aerodrome of the Royal Aircraft Establishment, Farnborough, by Flight-Lieut. M. J. Adam, using the Bristol 138 experimental high altitude aircraft. This was the same machine as used by Flight-Lieut. Swain, R.A.F., for the previous record, but was fitted with a special Bristol Pegasus engine. It had various detail improvements as suggested by experience. The pilot wore the actual high-pressure suit that was prepared as a reserve for the previous record flight, with small improvements. These included precautions against 'frosting up' of the Celestroid windows of the headpiece, and an emergency breathing pipe to lead air direct from the outside when necessary, instead of having to slash open the front of the headpiece as did Flight-Lieut. Swain, upon landing, after his flight. The transparent material forming the cabin roof was observed to crack upon reaching an altitude of about 48,000 feet, but this was not serious enough to interfere with the continuation of the flight.

The ascent was made in 1 hr. 35 min., and the total time of the flight was 2 hr. 15 min. The minimum pressure and temperature were 77·8 mm. of mercury and −48·9° C. respectively, both occurring at the maximum height. The pilot experienced a good deal of navigational trouble due to cloud-layers at intervals, at one time being forced to fly east, facing the sun, which at 6 a.m. was low enough to blind him. A steady north-westerly wind, estimated by the pilot to be of about 100 miles an hour velocity, was encountered in the upper regions. It is understood that the aircraft will continue to be employed upon researches into conditions of flight in the upper atmosphere.

Atlantic Air Mail Service

The first test flight of the Atlantic air mail service began on July 5 when the Imperial Airways flying-boat *Caledonia* left Foynes, Ireland, for Botwood, Newfoundland, and two and a half hours later the Pan-American Airways *Clipper III* took off from Botwood on the easterly crossing. The two boats alighted at their destinations within a quarter of an hour of each other on July 6. The *Caledonia*, under Captain A. S. Wilcockson, flew mostly at a height of 1,500 ft. to avoid the worst of the head-wind; she followed a rhumb line course at an average speed of about 132 miles an hour and was in the air for 15 hr. 28 min. The *Clipper III*, under Captain H. Gray, flew most of the way at 10,000 ft. to make the most of the following westerly wind; she kept roughly to a great circle course and her average speed was 156 miles per hour and flying time 12 hr. 37 min. Both commanders described the crossing as comparatively uneventful, and paid high tribute to the work of the wireless stations on both sides of the Atlantic in assisting their navigation.

Centenary of the General Register Office

An exhibition which opened on July 1 at the General Register Office, Somerset House, Strand, London, W.C.2, for a duration to be announced later, marks the centenary of the establishment of the general registration of births, deaths, and marriages in England and Wales, by illustrating the work of the Office, as well as the character of the records which are in its charge. Although the system of civil registration was established only one hundred years ago, its origins in England go back no less than four hundred years. Such statistical material relating to the population, outside the parochial records, as was recorded before 1837 was transferred to the custody of the Registrar General under the Marriage and Registration Acts of 1836. The earliest form of record, the parochial register of baptisms, marriages and burials, was established by Thomas Cromwell in 1538; but so long ago as the sixteenth century the value of demographic data and the inadequacy of the parochial system for this purpose were appreciated.

IN 1590, Lord Burleigh put forward a proposal for the establishment of an office for a general register to summarize "how many christenings, weddings and burials were every year in England and Wales". The proposal was not adopted; and subsequent attempts to secure some measure of systematic collection of facts were both unsatisfactory in working and incomplete, owing to increase in the number of nonconformists, who did not avail themselves of the services of the parish church. It was owing to this latter factor that the earliest records now preserved at Somerset House are those which did not come within the established order, belonging to the refugee churches of Walloons and French, the Chapels Royal, the Independents, and the Society of Friends of the sixteenth and seventeenth centuries. It is interesting to note that the last-named body, with characteristic precision, was the first to register births and deaths, rather than baptisms and burials. The official guide to the exhibition ("The Story of the General Register Office and its Origins from 1538 to 1937". Pp. 30+6 plates. London: H.M.S.O. 6*d*.) deals with these and other matters of much sociological interest, especially in the light thrown by the registers on the early history of nonconformity and the scandalous 'Fleet' marriages.

Ethnological Museums: Methods and Limitations

DR. H. S. HARRISON, in his presidential address to the Royal Anthropological Institute delivered on June 29, played the part of a wandering sceptic, to use his own term, to excellent effect in setting out some of the more striking shortcomings of the ethnological museum as a place of exhibition of material objects bearing on man's cultural development. As he pointed out, there is a considerable body of exhibits, such as, for example, musical instruments, personal ornaments, money and currency, which find their place in a museum as 'material objects', but of which the real significance is non-material and is lost on either the distributional or comparative method of arrangement, as their interest lies not in form or material, but in their sociological functions and meanings. Practical considerations limit the use of labels, quite apart from the danger of the museum becoming what Dr. Harrison said has been described as a collection of labels illustrated by exhibits. Dr. Harrison also showed himself a keen but kindly critic of the evolutionary method of display, pointing out its weaknesses in the scanty evidence and uncertainties relating to origins, the necessary, but at times excessive dependence upon inference, and the ambiguities of direction, including the possibility of degeneracy. Among the instances quoted in support of the argument he cited an interesting example in the uncertain development of the canoe and the relation of the plank and dug-out forms.

WITH a sympathy born of experience, Dr. Harrison recognizes the limitations imposed by space on experiment to meet defects inherent in present museum methods, but hopes for their alleviation in a National Anthropological Museum, which would be sufficiently spacious and catholic to deal with such problems. Notwithstanding his criticisms, as a museum man himself he believes firmly in the importance of the museum as a technological laboratory, forming an essential part in a school of ethnology. While anthropologists will warmly endorse his plea for a national anthropological museum, they will trust that his anticipation of its foundation before the close of the present century is a playful euphemism for "at no distant date".

Proposed Rhodes-Livingstone Memorial

To mark the jubilee of the foundation of the two Rhodesias by Cecil Rhodes in 1890 and the centenary of the setting out of David Livingstone for Africa in 1840, it is proposed to found a Rhodes-Livingstone Institute for Central African Studies in Northern Rhodesia. The main purpose of the Institute will be the study of the effect on native African society of the impact of European civilization and the urgent problem of establishing permanent and satisfactory relations between native and non-native. The proposal has the support of the Archbishops of Canterbury and York, the Right Hon. W. G. A. Ormsby-Gore, Lord Lugard, Lord Hailey, Dr. Henry Balfour, Sir William Bragg and others. It is proposed to purchase at a cost of £15,000 the premises now housing the Museum at Livingstone, the old capital of Northern Rhodesia, with the adjoining old Government House. The Museum contains objects of historical interest relating to David Livingstone and the nucleus of an important ethnographical collection. It was formed by the Government of Northern Rhodesia with assistance from the Beit Railway Trust, the Royal Geographical Society, the Scottish National Memorial at Blantyre and a number of individual benefactors. The premises will be vested in a trust, which will be responsible for administration and financial control. As a preliminary to the foundation of the Institute and the incorporation in it of the existing Museum, the Government of Northern Rhodesia has appointed an expert in applied anthropology, to whom an assistant will be added later if funds permit. Although the Rhodesian Government will bear its full share of the cost, an appeal is made for contributions towards the capital cost of the Institute and the endowment of the Trust to enable admirers of Livingstone and Rhodes to give material expression of their interest in them and the future of the country with which they were connected. Contributions may be directed to any branch of Barclay's Bank or the Standard Bank of South Africa.

British School of Archæology at Athens, 1935-36

IN accordance with the new arrangement for the publication of the "Annual of the British School of Archæology at Athens", the formal matter, which includes the report of the director covering the activities of members of the School during the year, the accounts, and the summary of archæological operations in the Greek area of the eastern Mediterranean in the preceding year, will in future be issued separately to subscribers, the report for the session 1935–36 being the first occasion on which the decision of the Committee takes effect. In the chronicle of the session precedence is taken by a reference to the lamented and untimely death of the director, Mr. Humfrey Payne, on May 9, 1936. Mr. A. H. G. Megaw, who took charge of the School as acting director, left in the following July to take up his duties on appointment as director of antiquities in Cyprus. Owing to the temporary closing of the British School of Archæology at Rome, a number of its students worked in the School at Athens. Excavations by members of the School were carried on at Monasteri in the Perachora, at Siphnos and at Trapeza in eastern Crete. Miss W. Lamb excavated at Kusura in Anatolia. Supplementary excavations in the Heræum of Perachora, which had been planned by Mr. Payne, were postponed until the following season. The manuscript of the account of the excavation of this important site was left in an advanced state by the late director, and it is anticipated that publication of the first volume will not be long delayed. In the chief descriptive notes of the activities of the School reference is made to some interesting discoveries in Crete. Although no further investigation of the Roman villa was possible, surface finds east of the basilica indicate that this was an important residential quarter of the Roman town in the first and second century A.D.

Speleological Conference at Bristol

FURTHER particulars of the second annual conference of the British Speleological Association to be held at Bristol on July 23–26 next (see NATURE, May 29, p. 919) are now available in the advance programme which has been issued. Through the hospitality of the University of Bristol the conference and exhibition will be held in the Great Hall of the University. The exhibition will include contributions from nearly all the important caves in the world, as well as some unique illuminated transparent photographs. Probably the largest and most valuable collection of 'Blue John' will be exhibited. On the evening of July 24 an illustrated public lecture will be delivered by the Abbé Breuil on some aspects of the French and Spanish caves. Among the lectures announced is a brief account by Mr. C. R. Hewer of some of the caves to be visited on the Continental tour on July 27–August 7 when members will have the opportunity of visiting caves not as a rule accessible to the public. At Nurnberg, after a visit to the Museum for Prehistory, the party will proceed to Teufelshöhle, Maximiliansgrotte, and other caves of archæological, geological and palæontological importance at Pottenstein, where also a mesolithic cave shelter has been especially excavated for the visit by the "Gaukulturamt". At Brno, Czechoslovakia, Prof. C. Absolon will conduct the party over the Museum, with its unique collection of archæological finds from the Moravian caves, which include remarkable examples of palæolithic plastic art; and in the afternoon of the same day the caves, which are the centre of the great mammoth hunters' culture of Moravia, will be visited. Passing through Vienna the party will proceed to the famous 'Drachenhöhle' from Mixnitz, the Lower Lurhöhle from Peggau and the Eisriesenwelt—ice cave from Werfen, the last place of call being Salzburg.

The Swiss Society of Natural Sciences

THE recent issue of the *Verhandlungen der Schweizerischen Naturforschenden Gesellschaft* contains an account of the annual meeting of the Society held at Solothurn in August 1936 and also reports of the work of the previous year. The object of the Society is to promote the study of all branches of natural science in Switzerland. Between the annual meetings for the presentation and discussion of papers, the work of the Society is carried on by a number of commissions. Some of these are concerned with the administration of endowments, while others undertake field work in various sciences. The latter are financed partly from members' subscriptions, but mainly from Government grants. Among the commissions performing work of national importance is the Geological Commission, which is engaged in the publication of a geological survey of Switzerland on scales of 1 : 25,000 and 1 : 200,000. In addition to the purely scientific commissions, there is a Commission for the Preservation of Nature, which is doing valuable work in preserving sites of scientific interest or scenic beauty, as well as in promoting legislation for the protection of forms of wild life which are in danger of extermination. Besides administering Government research grants, the Society also acts as the official representative of Switzerland on international scientific unions, and the volume under notice contains the reports of the Swiss delegations to a number of such unions.

THE presidential address at the annual meeting in 1936 was given by Dr. Karl Dändliker, who took as his subject, "Birth-Rate Decline and Surplus". He showed how, in spite of the excess of births over deaths, the population of many countries in Europe is bound to decrease before long. A paper was read by H. Brockmann on "Swiss Farm-Houses", in which two types of buildings were distinguished: one type has evolved from the use, by primitive man, of caves as shelters, while the other has evolved from tree shelters. Other papers read before the general meeting were "Inheritance by Labile Genes", by A. Ernst; "The Sting of the Bee", by M. Roch; "Ontogenesis of the Bird as a Problem in Evolution", by A. Portmann. These papers are all printed in full. In addition, abstracts are given of some 150 more specialized papers, dealing with nearly all branches of science, which were presented to the sectional meetings of the Society.

Royal Cornwall Polytechnic Society

THE one hundred and third annual report of the Royal Cornwall Polytechnic Society, besides containing the usual list of members, financial statements and an account of the work of the Falmouth Observatory, has several contributions of general interest. One of these is by Miss R. Beckett, who, in a paper on "Public Library Service", traces the growth of public libraries due to the Library Acts of 1850, 1855 and 1919. The Act of 1850 limited the rate to be levied to ½*d.* in the £ and that of 1855 to 1*d.* These sums proved quite inadequate, but it was not until 1919 that the penny rate limitation was abolished. In practice to-day, the average expenditure is 1*s.* 4*d.* per head of population, though some authorities expend as much as 2*s.* 6*d.* In another contribution, Mr. S. Furze deals at length with the operations involved and the machinery used in tin dressing, while in a third, Mr. J. H. Rowe gives the early history of Hayle Foundry, which was founded by John Harvey (1730–1803) and developed by his son Henry Harvey (1775–1850). This foundry was the earliest in Cornwall, and became ultimately the most important engineering works in the west of England. The well-known engineer Arthur Woolf (1766–1837), the pioneer of the compound steam engine, was at one time superintendent of this works, and it was there that he built some of the finest Cornish pumping engines of the time. The history of the Royal Cornwall Polytechnic Society inevitably recalls the Fox family, and the report has a tribute to Mr. Wilson Lloyd Fox, who died on February 10, 1936. He gained one of the Society's prizes in 1860, became a member in 1865, served as president in 1922–24, and was secretary of the Committee of the Falmouth Observatory from 1877 until 1931.

Intelligence, Character-training and Civilization

A LUDWIG MOND LECTURE entitled "Intelligence and Civilization", delivered at the University of Manchester last October by Prof. G. H. Thomson, of the University of Edinburgh, has been published in the first issue of the new *Journal of the University of Manchester*. After a preliminary discussion of some aspects of recent researches in the field of intelligence measurements, Prof. Thomson proclaims his belief (which was also H. T. Buckle's) that the history of the advance of civilization has been the history of the conquest of the world by intelligence. He preaches the salvaging of civilization "through the cultivation by an education proper to each of the intelligence of all". Of character-training he is profoundly distrustful. A clear vision of truth is, he assumes, to be attained solely through cultivation of the intelligence and "the schoolmaster's sole business is to lead his pupils to see truth clearly . . . and . . . that is the only character-training the school may lend itself to, if it is to refrain from serving party or class . . . but is to serve civilization". He does not think much of civilization's debt to the poets ("far more dangerous than scientists"), notwithstanding that he holds intelligence to be based on imagination, and he makes a point of registering disagreement with Earl Baldwin's hope, confided to the Congress of Universities of the Empire, that from those universities may presently come forth "poets who will inspire Europe and the world once more with a sense of unity and a sense of freedom".

The Utilization of Wood as Fuel for Motive Power

IN the *Bulletin* of the 'Société d'encouragement pour l'Industrie Nationale' of January is printed an abstract of a paper by R. Vaultrin on the utilization of wood as fuel for motive power. Towards the end of the Great War, the French Ministry of Inventions made experiments on carrying heavy loads between Paris and Rouen by motor-lorries provided with suitable gas generators using wood for fuel, but the results obtained were not good. In 1928, after a further rally with 'camions à gazogène', the problem was completely solved; but at that time the price of the wood fuel was too high to make it profitable. A notable rally was made in 1930 between Paris and Rome, crossing the Alps and the Apennines, and another was made through the Landes where resinous fuel was used and found suitable. Recent results for tourist vehicles gave 50 miles per hour consuming about 70 lb. of firewood, costing six francs for a sixty miles run. Heavy motor-lorries can run at 30 miles per hour, the cost for sixty miles being fifteen francs. In France, there is an annual overproduction of thirteen million cubic yards of firewood. This would be sufficient for 60,000 motor-vehicles using gas generators. At the moment, the difficulty is to obtain, on the road, supplies of suitable wood with constant humidity. This double problem has been solved between Frankfort and Cologne. In France there are already large stores on a 'national' road, and all the main routes on the east are being supplied with stores. The control of the humidity of the wood distributed is being studied.

Electric Furnaces

DURING last year the use of electricity for the melting and heat treatment of iron and steel in Great Britain considerably increased. There has been a revival in the demand for arc furnaces, a number of which, varying in capacity from 500 to 6,000 kilowatts, are being installed. In the *Electrical Review* of April, Mr. D. Campbell states that the furnaces ordered from a single manufacturing company during last year would consume about a 100 million electric units a year. The cost of the annual power bill for these furnaces alone would be about £200,000. A furnace of 6,000 kilowatt capacity, probably the largest electric melting unit in Europe, has just begun operation in Sheffield. Within its small area of furnace hearth (13 ft. diameter), as much energy is consumed per day as the aggregate loads of Cambridge, Salisbury and Tonbridge. Unfortunately, the requirements of larger and interconnected power stations make it essential to install higher rupturing capacity switch-gear, and this constitutes a heavy charge on small firms which may want to use electric furnaces. Seeing that the cost of the energy consumed by the furnace during its average life (ten years) is about thirty times the original cost of the complete installation, the companies should offer attractive conditions to steel manufacturers. The extreme purity of arc furnace steel owing to the absence of slag inclusions is now generally recognized, and for many types of forging this steel is specified. The choice between high-frequency furnaces and arc furnaces is difficult to make. Although the capital expenditure for high-frequency furnaces is much higher, yet when melting operations only are required they are cheaper to work.

Astronomy in Japan

The Kyoto Imperial University has accepted a donation equivalent to about £10,000 from the Osaka Electric Railway Co. towards the building of an observatory on the southern peak of Ikomasan at a height of 640 metres. The observatory will include a main building with a 9-metre dome, a solar laboratory, housing for a reflector and a dormitory. The equipment of the solar department of the Kwasan Observatory is to be transferred to this new site, in addition to other instruments including the 80-cm. Tomkins reflector. Later a large museum devoted to astronomical exhibits and those of allied sciences will be built near the Ikomasan Observatory. Prof. Yamamoto will be the director of the group. The Kwasan Observatory will then become a purely academic institution. The Osaka Municipal Electric Museum, which has recently been completed, includes a Zeiss planetarium, which is installed under an 18-metre dome on the sixth floor of the Museum. *Bulletin* No. 326 of the Kwasan Observatory directs attention to a daily series of sunspot observations made for fourteen years by Mr. Katue Misawa, whose failing eyesight now prevents the series from being carried on. The observations, which have been made regularly under excellent weather conditions, have been of great use in supplying data with the minimum delay to Japanese investigators. Observations of the zodiacal light are receiving special attention in Japan, and it is planned to establish a special observatory at Onomiti, Hirosima-Ken, at a height of 150 metres. The observed longitude of the Kwasan Observatory, deduced from 74 observations made with the 90 mm. Bamberg transit in conjunction with the reception of Greenwich wireless time signals, is $-\ 9^{h}\ 3^{m}\ 10{\cdot}315^{s} \pm 0{\cdot}002^{s}$ or E. $135^{\circ}\ 47'\ 34{\cdot}72'' \pm 0{\cdot}03''$. The elements of latitude variation for the epoch 1934·0–1935·9 computed by Dr. Kimura from data provided by five northern stations are given in *Bulletin* No. 322.

Hygiene in the Bacon Factory

With this title, *Bull.* No. 1, published by the Bacon Development Board, Thames House, London, S.W.1 (1*s*.), lays down certain standards of sanitation as a condition of every licence to produce bacon, and describes in some detail a system of sanitation which, if adhered to, will assist curers to comply with the conditions of their licence, and help them, in their own interests, to reduce the risk of spoilage of their products. The construction, maintenance and equipment of the factory are first discussed, after which the daily and the periodical cleaning of the premises are described. Next, the keeping of the meat and bacon clean and wholesome, and the personal hygiene of the employees are dealt with. Data are given in an appendix upon sources and reduction of contamination and the use of sodium hypochlorite as a disinfecting agent.

Brown-Firth Research Laboratories

A brochure of some seventy pages deals with the equipment and work of the Brown-Firth Research Laboratories in Sheffield. The various types of research undertaken are described briefly, and the apparatus used is illustrated. A long list of original papers which have been published is appended, together with a catalogue of books, manuscripts and reports available in the library. To all who are concerned in any way with the development of modern steels, this publication cannot fail to be of interest.

1851 Exhibition Studentships and Scholarships

The science scholarship committee of the Royal Commission for the Exhibition of 1851 has recently awarded the following senior studentships and overseas scholarships, upon the recommendations of the universities and other institutions named: Senior Students. Dr. H. J. Bhabha (University of Cambridge), for research in theoretical physics at Cambridge; Dr. H. N. Rydon (Imperial College of Science and Technology), for research in organic chemistry at Oxford; Dr. J. L. Harley (University of Oxford), for research in mycology at Oxford; Dr. A. H. S. Holbourn (University of Oxford), for research in experimental physics at Oxford. A fifth Studentship was given to Dr. T. S. Westoll, who was a palæontologist recommended by University College, London, but he has been appointed to a lectureship at Aberdeen and therefore will not take up the award. Overseas Scholarships. *Canada:* Mr. A. J. C. Wilson (Dalhousie University, Halifax), for research in physics at the Massachusetts Institute of Technology and the University of Cambridge; Mr. D. M. Ross (Dalhousie University, Halifax), for research in experimental zoology at the University of Cambridge; Dr. H. Rudoff (McGill University, Montreal), for research in organic chemistry at the University of Oxford; Dr. J. L. Morrison (McGill University, Montreal), for research in physical chemistry at the University of Cambridge; Mr. A. G. Ward (Queen's University, Kingston), for research in physics at the University of Cambridge. *Australia:* Mr. R. D. Hill (University of Melbourne), for research in physics at the University of Cambridge ; Miss K. L. Prendergast (University of Western Australia), for research in palæontology at the University of Cambridge. *New Zealand :* Mr. I. Lauder (University of New Zealand), for research in physical chemistry at the University of Manchester. *South Africa :* Mr. F. Sebba (University of Cape Town), for research in inorganic chemistry at the Imperial College of Science and Technology. *Irish Free State :* Mr. D. A. Webb (Trinity College, Dublin), for research in zoology at the University of Cambridge ; *India :* Mr. N. S. Nagendra Nath (Indian Institute of Science, Bangalore), for research in theoretical physics at the University of Cambridge.

THIS is the first occasion on which a scholar from India has been included in the Overseas scheme of the Royal Commission for the Exhibition of 1851 ; and the award of the scholarship has been made possible by the action of H.M. Treasury in extinguishing the balance of the liability for contributions to the cost of new buildings for the Science Museum. The following preliminary selection committee was appointed by the Government of India to sift applications in India for the scholarship : Mr. J. E. Parkinson, Educational Commissioner with the Government of India (chairman) ; Dr. S. S. Bhatnagar, professor of physical chemistry, Punjab University ; Sir C. V. Raman, director of the Indian Institute of Science, Bangalore ; Dr. Birbal Sahni, professor of botany, Lucknow University. The names of three candidates for the scholarship were submitted by the committee to the Commissioners, who decided on June 30 to award the scholarship to Mr. Nath. In addition, it is worth mention that though Indian students, like all other British subjects, have always been eligible for Senior Studentships, if recommended by a university in the United Kingdom, Dr. H. J. Bhabha is the first native of India to be awarded such a studentship. He has made several original contributions to the correspondence columns of NATURE and is well known among workers in theoretical physics.

Rockefeller Travelling Fellowships in Medicine

THE Medical Research Council has awarded Rockefeller fellowships to the following for the academic year 1937–38 : D. L. C. Bingham, clinical tutor, Surgical Outpatient Department, Royal Infirmary, Edinburgh ; E. G. L. Bywaters, assistant clinical pathologist, Middlesex Hospital, London ; P. R. Evans, registrar, Medical Diseases of Children, King's College Hospital, London ; J. G. Sclater, tutor in clinical medicine, Royal Infirmary, Edinburgh ; Dr. E. F. Scowen, assistant director, Medical Professorial Unit, St. Bartholomew's Hospital, London ; Dr. C. H. Stuart-Harris, Sir Henry Royce research fellow in influenza, London ; G. W. Hayward, resident medical officer, National Hospital for Diseases of the Heart, London. All these fellows propose to work at centres in the United States. In addition, the Rockefeller Foundation has awarded fellowships, on the recommendation of the Medical Research Council, to the following candidates in the special field of psychiatry, neurology and related subjects : Dr. E. W. Anderson, medical director, Cassel Hospital, Penshurst ; Dr. A. Kennedy, assistant medical officer, Maudsley Hospital, London ; A. S. Kerr, surgical registrar, Royal Infirmary, Liverpool ; Dr. D. J. Williams, resident medical officer, Hospital for Nervous Diseases, Maida Vale, London ; Dr. A. F. Rawdon-Smith, senior student, Royal Commissioners for the Exhibition of 1851, working in the Psychological Laboratory, University of Cambridge. Dr. Anderson proposes to work in Germany, the others at centres in the United States.

Announcements

THE following have recently been elected honorary fellows of the Royal Society of Edinburgh : *British* : Dr. W. T. Calman, lately keeper of zoology, British Museum (Natural History) ; J. L. Baird, inventor of the 'Televisor'. *Foreign* : Prof. C. U. Ariëns Kappers, director of the Central Institute of Brain Research, Amsterdam, and professor of comparative neurology in the University of Amsterdam ; Prof. M. T. Bogert, professor of organic chemistry in Columbia University, New York ; Prof. Max Planck, emeritus professor of theoretical physics and director of the Institute for Theoretical Physics in the University of Berlin.

DR. G. W. SCOTT BLAIR, of the physics department, Rothamsted Experimental Station, has been appointed head of the chemistry department at the National Institute for Research in Dairying, Shinfield, near Reading. Dr. Scott Blair, who is a chemistry graduate of the University of Oxford, joined the Rothamsted staff in 1926. He has worked on the physico-chemical properties of various agricultural materials such as soil, flour, honey and cheese. During one part of his Rothamsted service he held a Rockefeller Fellowship at Cornell University.

DR. F. W. EDWARDS has been appointed a deputy keeper in the Department of Entomology of the British Museum (Natural History). Dr. Edwards was born in 1888 and entered the Museum service in 1910. He is an authority upon Diptera. He undertook very successful collecting expeditions on behalf of the Museum to Patagonia in 1926–27 and to East Africa in 1934–35, as well as several smaller expeditions.

THE fourth Congress of the Medical Women's International Association will be held on July 13–18 at the McEwen Hall in Edinburgh. Further information can be obtained from the Local Congress Secretary, 2 Chester Road, Edinburgh.

MESSRS. JAMES TREGASKIS AND SON, 66 Great Russell Street, London, W.C.1, have issued a catalogue of old works on medicine and biology (Caxton Head Bulletin 21). It includes a copy of the rare first edition of Darwin's "Origin of Species", Gesner's "Treasure of Euonymus" (1559), Laennec's "Traité de l'auscultation mediate" (Ed. 4, 1837), the "Opera" (1582) of A. Paré, the great medieval surgeon, and other rare volumes.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 71.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Heat Conduction in Liquid Helium

IT was found by Rollin[1] and by Keesom and Keesom[2] that liquid helium II shows an extraordinarily high heat conductivity, of the order of 190 cal./deg.cm.sec. We have measured the heat conductivity with the following method, which is essentially a combination of a vapour-pressure thermometer with a liquid-helium manometer. (The method was developed in discussion with Dr. J. D. Cockroft.)

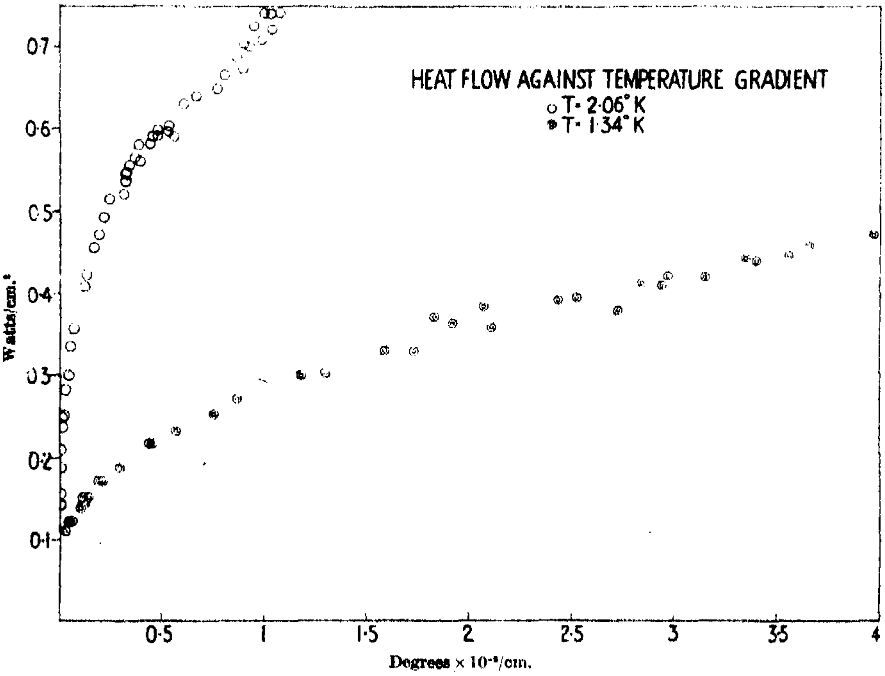

Fig. 1.

An evacuated glass vessel is immersed in a helium bath. It contains a vertical cylindrical bulb, the bottom of which communicates with the outer bath through a glass capillary. The bulb also contains a heater wire through which a current can be passed. This current is so adjusted that part of the helium in the bulb evaporates, and only part of the bulb is filled with liquid. The level of the liquid is observed in a telescope and its height compared with the level of the bath. In equilibrium, the difference in height is such that the difference in hydrostatic pressure is equal to the difference in vapour pressure. In this way one obtains the temperature difference between the bulb and the bath, and this is practically also the temperature difference between the two ends of the capillary. For example, at 2·10° K., a level difference of 1 cm. corresponds to a temperature difference of $1\cdot32 \times 10^{-3}$ deg. Since, on the other hand, the heat flow through the capillary is equal to the heat produced in the wire, one can determine the conductivity.

It is essential for this method that one should actually obtain equilibrium, but it is easily estimated from the observed conductivity that equilibrium should be established in a fraction of a minute, and it was indeed observed that the level followed a change in the current very rapidly and reversibly. It is also easy to see that the heat conduction in the glass, in the leads carrying the current, etc., is negligible. In order to avoid convection, the warm end of the capillary was arranged to be lower than the cold end (the expansion coefficient of helium is negative).

Preliminary experiments showed the unexpected result that the conductivity depends on the temperature gradient. We therefore used an arrangement in which the level difference could vary from 12 cm. to about 0·3 mm., and measured the heat flow as a function of the temperature difference ΔT between the ends of the capillary. In this case the capillary was 16·8 cm. long and had an internal diameter of 1·45 mm. The results are shown in Fig. 1, for bath temperatures of 2·06° and 1·34° K. It is clear that the heat flow is far from being proportional to ΔT, even for the lowest temperature differences we used. The ratio of heat flow to temperature gradient, which one may call conductivity, increases with decreasing ΔT. It reaches the value $1\cdot1 \times 10^4$ cal./deg.cm.sec. at $\Delta T = 5 \times 10^{-6}$ and $T = 2\cdot06$. It appears, however, to rise still further and a refinement of the method is required to decide whether it tends to a finite value as ΔT tends to 0.

Qualitative measurements at a number of different temperatures between 1·34° and 2·19° showed the same general behaviour. At constant ΔT, the conductivity is relatively small near the λ-point (2·19°), reaches a maximum in the neighbourhood of 2·0° and decreases again at lower temperatures.

We cannot suggest an explanation for these results, for which there is no analogy in the behaviour of other substances. It seems impossible, however, to account for them by any errors in the experimental method; the effect seems actually to be a property of the liquid helium II.

J. F. ALLEN.
R. PEIERLS.
M. ZAKI UDDIN.

Royal Society Mond Laboratory,
Cambridge.
June 22.

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[1] *Physica*, 2, 557, (1935).
[2] *Physica*, 3, 859, (1936).

Analysis of Ternary Gas Mixtures by Thermal Conductivity Measurements

IT frequently happens in the course of exchange reactions with deuterium and hydrogen that a third gas is present initially, or is produced during such experiments (for example, nitrogen in exchange reactions with ammonia and deuterium). If this gas is non-condensable in liquid air, the deuterium content of the gas cannot be estimated by the convenient thermal conductivity methods, unless a trap cooled with liquid hydrogen is employed to freeze out the third constituent of the mixture. The gases concerned are oxygen, nitrogen, carbon monoxide and methane and the inert gases. The only alternative method is to burn the gases and measure the deuterium content of the water so produced.

The thermal conductivity method described below surmounts this difficulty. Its operation depends on the fact that the thermal conductivity of hydrogen decreases rapidly below 200° K., owing to the decrease in rotational specific heat of the molecule. The thermal conductivity of deuterium, on the other hand, only decreases slowly, since the rotational specific heat remains practically constant down to about 80° K. For example, at 250° K. the ratio of the thermal conductivities is 1·384 : 1; at 75° K. it is 1·095 : 1. Consider now a ternary mixture containing hydrogen, deuterium and a third gas (*X*). At high temperatures (*c*. 250° K.) a whole series of mixtures will have the same thermal conductivity—as is exemplified by the full lines on the ternary diagram (Fig. 1). At 75° K., however, the isothermal conductivity lines will be more nearly parallel to the hydrogen-deuterium side of the triangle, as is indicated by the dotted lines. To perform an analysis of an unknown mixture, then, it is only necessary to measure the thermal conductivity at these *two* temperatures: if, for example, the respective thermal conductivities correspond to the lines *aa* and *bb*, the point of intersection at once gives the composition of the mixture.

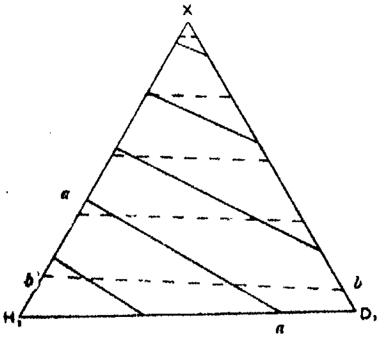
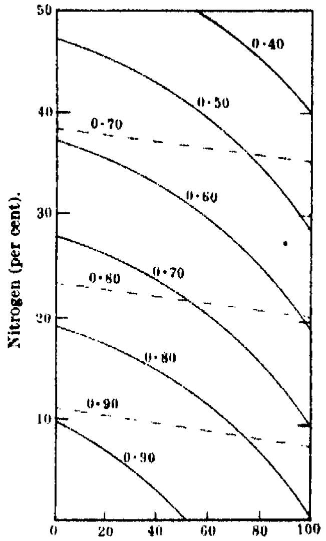


Fig. 1.



Deuterium content of hydrogen.

Fig. 2.

In practice, the analysis may be carried out by compressing the mixture to a standard pressure, for example, 50 mm., into a micro thermal conductivity cell, of volume 0·05 c.c. (that is, requiring about 0·01 c.c. gas at N.T.P.), dipping into liquid air and attached to the compression capillary of a McLeod gauge[1]. The voltages required to maintain the filament at the two chosen temperatures are determined. The isovolt lines obtained for hydrogen-deuterium-nitrogen mixtures are shown in Fig. 2. The filament temperature was 300° K. and 110° K. in the case of the full and dotted lines respectively. The observed voltage value, relative to that required for pure hydrogen, corresponding to each isovolt line is indicated. The observed curvature of the high-temperature lines is attributable to mixture effects. For mixtures of nitrogen-content not exceeding 50 per cent, the accuracy of the method is about 1 per cent deuterium.

It is evident that this method may be applied to any ternary mixture, one component of which is hydrogen and the other two, gases of different thermal conductivity. Mixtures of ortho- and para-hydrogen and a third gas may likewise be analysed.

J. L. BOLLAND.
Chemistry Department,
University,
Edinburgh.

H. W. MELVILLE.
Colloid Science Laboratory,
Cambridge.
May 21.

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[1] Melville and Bolland, *Proc. Roy. Soc.*, in press.

Artificial Slip Formation in Crystals.

WHAT is the cause of the plasticity and low elastic limit of crystals ? No satisfactory answer has as yet been found to this fundamental question in crystal physics. The results of experiments, briefly described in the present note, establish one of the factors determining the course of the plastic deformation.

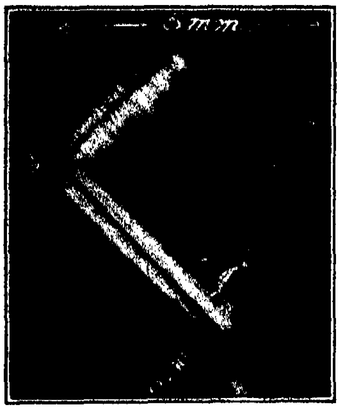

Fig. 1.

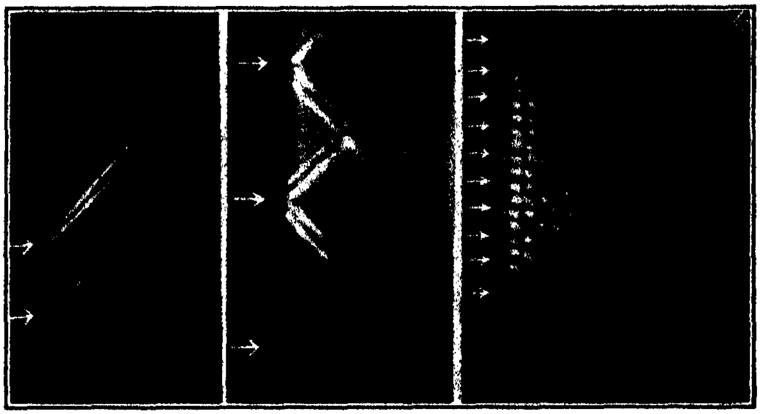
(a) (b) (c)

Fig. 2.

A scratch was made on a rectangular specimen of rock salt with faces parallel to the cube faces. The scratched crystal was placed between crossed Nicols and stretched. The influence of the scratch on the process of slip formation was observed with polarized light.

The main result may be summarized in the statement that a scratch is the source of the slip.

The gradual propagation of the slips beyond the region of the scratch, and their growth throughout the bulk of the crystal, were observed directly. The bright rays in Fig. 1, Fig. 2 *a* are artificially produced slips. They were especially pronounced when the scratches were made on specimens the original surfaces of which had been previously dissolved away.

The picture formed by the artificially produced 'slips' depends upon the experimental conditions. With different positions of the scratches on the surface of the crystal, we could obtain any desired slip patterns. Fig. 2 *b* corresponds to three parallel scratches at a distance of 5 mm. from each other. Fig. 2 *c* corresponds to 10 parallel scratches at a distance of 0·5 mm. from each other.

A number of details in the photographs may be noted, such as (1) the increased illumination in the parts lying along the locus of the intersection of the slips, with a straight line drawn at an angle of 45° to the axis of the specimen from the scratch (see Fig. 1, dotted in the upper ray) ; (2) the direction of the slips deviates considerably from 45° (see Fig. 2 *a*) ; (3) the interference of several scratches (see Fig. 2 *c*), etc. Fig. 3 shows a part of one of the rays reproduced in Fig. 1 at a greater magnification.

It appears that the plastic deformation of crystals cannot be explained by a simple slipping mechanism. The rupture takes place along the scratch. The process of rupture proceeds as follows : the surface defect gives rise to the appearance of slips, which in their turn lead to the development of a surface defect, which ends in fracture.

The state of the surface and local deformation are probably also of importance in twinning.

All the photographs show the artificially created slips in polarized light. The axes of the Nicols are parallel to the cube axes. The scratches are made in the direction (100) normally to the plane of the picture. The arrows indicate their position. The scratches were produced by means of a Martens sclerometer.

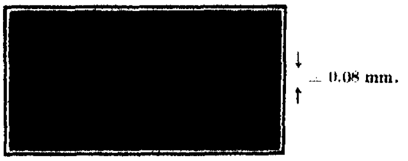

Fig. 3.

A detailed account of these experiments will shortly be published in the *Phys. Zeitschrift der Sowietunion*.

A. W. STEPANOW.

Physico-Technical Institute,
Leningrad.

Coupling of Dismutations with Esterification of Phosphate in Muscle

THE disappearance of free phosphate during glycogenolysis in muscle extract is a striking phenomenon. One mechanism by which this occurs has recently been elucidated by Parnas and his colleagues[1], who showed that, even in long-dialysed extracts, phosphate and glycogen can react together giving hexosemonophosphate. This reaction is poisoned by $M/100$ phloridzin, but not by $M/400$ iodoacetic acid. We have observed a second method of phosphate esterification.

A certain dependence of esterification of carbohydrate upon dismutation has from time to time been observed, for example, by Meyerhof and Kiessling[2] in yeast and muscle extract, by Schäffner and Berl[3] in yeast extract, and by Dische[4] in red blood cells and hæmolysed blood. Dische mentions having found an increase in easily hydrolysable phosphate during this esterification, and suggested that the synthesis of adenylpyrophosphate might be an intermediate step. We now show that in the second method of phosphate esterification in muscle extract the dismutation of triosephosphate with pyruvic acid (giving phosphoglyceric and lactic acids) is coupled with a synthesis of adenylpyrophosphate from adenylic acid and free phosphate.

As enzyme preparation we used extract of acetone muscle powder (rabbit) prepared according to Meyerhof's technique. In order to destroy adenylpyrophosphatase (the activity of which would have masked any adenylpyrophosphate synthesis) we kept the *extract at* 0° *for five days before use*; the extracts were also dialysed for four hours to remove any remaining traces of substrate. Typical results are given in Table 1. It will be observed that (1) iodoacetate, which inhibits the dismutation, inhibits also the esterification, (2) phloridzin does not inhibit either dismutation or esterification, (3) arsenate inhibits the esterification without affecting dismutation.

TABLE 1.

1 c.c. extract made up to final volume of 2·5 c.c.; with *M*/100 hexosediphosphate, *M*/50 pyruvate, *M*/50 fluoride, *M*/30 phosphate, *M*/200 adenylic acid, present in each sample. 0·4 mgm. co-zymase present in each. 30 min. incubation at 37° C. The figures give increases and decreases in mgm.

Exp.		Lactic acid	Phosphoglyceric P	Inorg. P.	Pyro P.
IV		+ 1·58	+ 0·57	– 0·62	+ 0·66
V	No iodoacetate	+ 1·80		– 0·78	+ 0·72
	+ iodoacetate	+ 0·32		0	0
XVIII	No phloridzin	+ 4·56		– 0·51	+ 0·57
	+ phloridzin	+ 3·87		– 0·45	+ 0·66
XIX	No arsenate	+ 4·26		– 0·69	
	+ arsenate	+ 4·98		– 0·18	

Iodoacetate *M*/400: phloridzin *M*/100: arsenate *M*/75.

The dismutation of α-glycerophosphate with pyruvate, and the dismutation of hexosediphosphate to give glycerolphosphate and phosphoglycerate can be coupled with the phosphorylation of adenylic acid.

As regards the mechanism of the coupling, it can be said (1) that we have tested our extracts for adenylpyrophosphatase activity and found it to be nil. It seems, therefore, that the coupled esterification cannot be dependent upon a reversed reaction catalysed by this enzyme. (2) We have examined the ratio of lactic acid formed to phosphorus esterified. The results indicate that, according to the conditions, a greater or less proportion of the dismutation can be coupled with adenylpyrophosphate synthesis, but that however favourable the conditions, probably not more than one atom of phosphorus can be esterified per molecule of lactic acid formed.

This coupled esterification of phosphate probably plays an important part during the anaerobic recovery period when creatinephosphate is resynthesized, free creatine and free phosphate disappearing. Making use only of the Parnas mechanism of esterification of glycogen by free phosphate, and of the mechanism whereby phosphate is transferred from phosphopyruvic acid to adenylic acid, it seems possible to account for the resynthesis of only ½ mol. creatinephosphate per mol. lactic acid produced. Both Meyerhof[5] and Parnas[6] have pointed out that Lundsgaard[7] has actually observed a much greater synthesis than this—2 mol. creatinephosphate per mol. lactic acid formed. *By taking into account the* coupled esterification, synthesis of 1½ mol. of creatinephosphate per mol. lactic acid can be expected. This is a value much nearer Lundsgaard's observed results. Further, during anaerobic recovery there is very little heat output; this can only be explained if the energy of dismutation is not evolved. We here suggest that it is retained and used to make possible the endothermic synthesis of adenylpyrosphosphate.

These considerations will be dealt with in detail elsewhere.

DOROTHY M. NEEDHAM.
R. K. PILLAI.

Biochemical Laboratory,
Cambridge.
June 3.

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[1] Parnas and Baranowski, *Comptes rend. Soc. Biol.*, **120**, 307 (1935). Ostern, Guthke and Terszakowec, *Z. physiol. Chem.*, **242**, 9 (1936). Parnas and Mochnacka, *Comptes rend. Soc. Biol.*, **123**, 1173 (1936).

[2] Meyerhof and Kiessling, *Biochem. Z.*, **281**, 449; **283**, 83 (1935).

[3] Schäffner and Berl, *Z. physiol. Chem.*, **238**, 111 (1936).

[4] Dische, *Naturwiss.*, **22**, 776 (1934); **24**, 462 (1936).

[5] Meyerhof and Lehmann, *Naturwiss.*, **23**, 337 (1935).

[6] Parnas and Ostern, *Bull. Soc. Chim. Biol.*, **18**, 1471 (1936).

[7] Lundsgaard, *Biochem. Z.*, **233**, 322 (1931).

An Oxyporphyrin Hæmatin Compound as Intermediate between Protohæmatin and Verdohæmatin

IN our letter on "Coupled oxidation of ascorbic acid and hæmochromogens"[1], we had observed the formation of a hæmatin compound with an absorption band at 639 mμ during the coupled oxidation of pyridine-hæmochromogen and ascorbic acid. The same compound was formed by action of hydrogen peroxide on the hæmochromogen in presence of ascorbic acid. On reduction it gave a hæmochromogen with the bands of protohæmochromogen. From these observations we had concluded that the compound was a hydrogen peroxide compound of protohæmochromogen.

We have now found that the hæmochromogen, obtained by reduction of the compound with the absorption band at 639 mμ, is not protohæmochromogen, but a hæmochromogen of a new type. The position of its absorption bands is almost the same as the position of the protohæmochromogen bands (557·4 and 526·3 mμ), but the second band is stronger than the first, whereas in protohæmogen the first band is the stronger of the two. A hæmochromogen of a similar type is that of phylloporphyrin[2], a porphyrin carrying methyl on one methene group. By atmospheric oxygen the new hæmochromogen is rapidly oxidized to verdohæmochromogen, a hæmochromogen with open tetrapyrrolic chain. On splitting with hydrochloric acid in absence of oxygen, the new hæmochromogen gives rise to an oxyporphyrin, which resembles the oxyporphyrins obtained by H. Fischer and collaborators by action of hydrogen peroxide on porphyrins in concentrated sulphuric acid[3]. The absorption spectra of the oxyporphyrins of Fischer and also of our oxyporphyrin are similar to those of chlorins and rhodins, but whereas the copper and iron complex salts of Fischer's oxyporphyrins are also chlorin-like, the complex salts of our oxyporphyrin are of the phylloporphyrin type.

The most likely explanation appears to be that our hæmochromogen is the iron complex salt of an oxyporphyrin carrying a hydroxyl group on the α-methene group. By action of molecular oxygen on the oxyporphyrin-hæmatin, this carbon atom is then removed and the porphin ring opened. Fischer's oxyporphyrins carry their hydroxyls probably not on the methene group, but in the β-positions of a hydrogenated pyrrole nucleus[4]. The compound with the absorption band at 639 mμ is the ferric hæmochromogen of the oxyporphyrin, and not a hæm-hydrogen peroxide compound.

The conclusions, drawn from the existence of the supposed hydrogen peroxide compound with regard to the reaction mechanism of the coupled oxidation of hæmochromogen and ascorbic acid, remain, however, correct. Hydrogen peroxide plays a part in this reaction, transforming porphyrin-hæmatin into oxyporphyrin-hæmatin. There is also evidence in favour of the existence of a hæm-hydrogen peroxide compound during the reaction. Whereas catalase completely prevents the formation of the oxyporphyrin-hæmatin from hæmochromogen and hydrogen peroxide, catalase inhibits the formation of this compound (and of verdohæmochochromogen) by atmospheric oxygen only partially. The most likely explanation is that the 'nascent hydrogen peroxide' is protected from the action of catalase by its combination with the molecule with which it is to react afterwards (that is, the hæm), and that the partial inhibition of the reaction by catalase is due to a partial dissociation of the hæm-hydrogen peroxide compound and catalytic destruction of the hydrogen peroxide set free by the dissociation.

R. LEMBERG.
Institute of Medical Research, B. CORTIS-JONES.
Royal North Shore Hospital, M. NORRIE.
Sydney. May 15.

[1] NATURE, **139**, 1016; 1937.

[2] Treibs, A., and Wiedemann, E., *Liebigs Ann.*, **466**, 264 (1928).

[3] Fischer, H., Halbig, P., Walach B., *Liebigs Ann.*, **458**, 268 (1927). Fischer, H., Gebhardt, H., and Rothhaas, A., *Liebigs Ann.*, **482**, 1 (1930).

[4] Fischer, H., and Lautsch, W., *Liebigs Ann.*, **528**, 247 (1937).

Mechanism of the Glass Electrode

IT is a well-known fact that new glass electrodes are not suitable for exact measurements until they have first been allowed to stand in water for some time. The continuous variation in potential observed with a new electrode may be connected with the property of the glass of taking up hydrogen ions. I have demonstrated[1] that hydrogen ions are exchanged for calcium and sodium ions in the glass electrode. The following experiments demonstrate the relation of the potential to the hydrogen ion uptake.

A series of bottles containing 2 gm. each of glass powder and 30 ml. of 0·1 *n* HCl were shaken at 25°. At different times bottles were removed and the liquid titrated with 0·1 *n* NaOH. From these data the amount of 0·1 *n* HCl (C_t) disappearing, equivalent to the amount of H taken up by the powder, after various lengths of time were found. The results of the titrations are given in Curve *A* (Fig. 1).

In order to determine whether measured potentials agree with those calculated from consideration of the chemical changes which occur, the following experiment was performed.

A spherical glass electrode was placed in each arm of a U-tube containing 30 ml. 0·1 *n* HCl and 2 mgm. glass powder in order to approximate the conditions in the experiment previously described. The inside of *both* electrodes and the outside of *one* of them had been in contact with 0·1 *n* HCl for a month, but the remaining outer surface had *never* been in contact with any solution. Silver wires covered with silver chloride were placed in contact with the inner liquid of both electrodes. The potentials of this system were measured periodically and the data obtained are represented by Curve *B* (Fig. 1).

In order to correlate the hydrogen ion uptake and the above-mentioned change in potential of new electrodes, the following assumptions have been made. The initial hydrogen ion activity of the glass is assumed to be Pc_0, where P is a constant, and c_0 is the number of hydrogen ions in the untreated glass per arbitrarily chosen unit of glass surface. At any time, t, after the immersion of the new electrode in hydrochloric acid, the number of hydrogen ions taken up is c_t, and the activity is now assumed to be equal to $P(c_0 + c_t)$. Hence the variation of potential with time of the system is, when π is measured in millivolts, given by the equation :

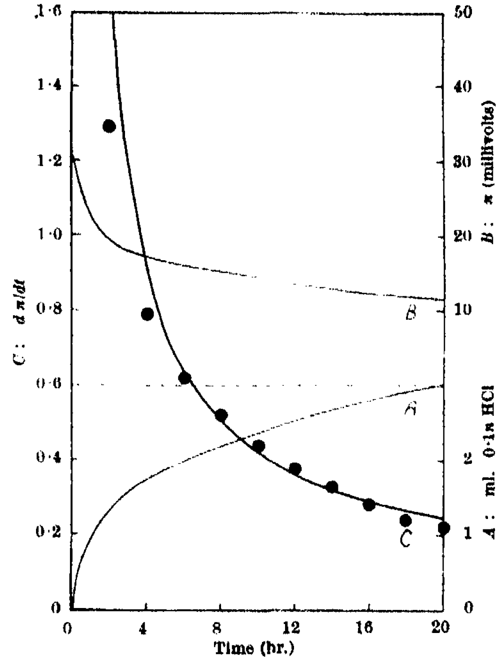

Fig. 1.

$$\frac{d\pi}{dt} = \frac{RT}{F} \cdot 1{,}000 \; \frac{1}{c_0 + c_t} \; \frac{dc_t}{dt}$$

The values of $d\pi/dt$ and dc_t/dt at definite times are found graphically from Curves *A* and *B* in Fig. 1. The value 2·51 was found to be an approximation for c_0. The details of the method of determining this value will be published elsewhere. This value means that 2 gm. of glass powder at the start of the experiment has a H ion content equivalent to 2·51 ml. 0·1 *n* HCl.

In Fig. 1, Curve *C* was constructed from the data obtained in the glass powder experiment and the points represent the values of $d\pi/dt$ derived from potential measurements.

From these experiments it appears that the suitability of a glass as an electrode depends upon its ability to exchange sodium and calcium ions for hydrogen ions. These experiments also confirm the hypothesis of Horowitz[2] published in 1923. From this point of view it should be possible to produce sodium, calcium and potassium electrodes by choosing a glass of the proper composition or a mineral of the permutit type. I am carrying out further investigations of these possibilities.

Carlsberg Laboratory, G. HAUGAARD.
Copenhagen.
May 12.

[1] *Tidskr. Kjemi og Bergvesen*, No. 4 (1937).

[2] *Z. Phys.*, **15**, 369 (1923).

Controlled Cathode Sputtering

THE object of these experiments is to obtain accurate measurements relating to the phenomenon of cathode disintegration in gaseous discharges.

The apparatus consists essentially of a strong ion-source of the Lamar-Samson-Compton type[1], capable of delivering 2 milliamperes of singly-charged argon ions, and of an adjacent 'sputtering chamber' maintained at about 2×10^{-4} mm. mercury pressure, where the material to be tested is sputtered and measurements relating to that process are made.

The first objective is to obtain measurements of the amount of material sputtered per unit time as a function of the ion-current density and ion-energy. As shown in the diagram (Fig. 1), the ions emerging from the source (which is earthed) are allowed to impinge on and sputter a target maintained at a negative potential. Some of the material sputtered is deposited on a mica collector placed in front of the target, and supported by a horizontal fine quartz fibre. The weight of the deposit collected (a few milligrams) can readily be determined by observing the deflection of the fibre by means of a microscope. This allows measurement of the relative rates of sputtering. The total amount of material sputtered can be computed in cases where the law of angular distribution of sputtered deposit over a sphere is known[2].

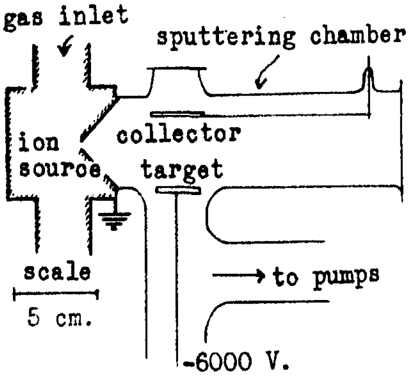

Fig. 1.

The rate of sputtering of gold by argon ions of 6,000 volt energy has been determined. The sputtering rate is sufficient to deposit measurable amounts in 3¼ hours. With decreasing ion energy the rate of deposition decreases, and for ions of 2,000 volt energy, about 10 hours would be required to deposit a measurable amount. This is the maximum period over which the apparatus has been operated steadily. Because of the complicated nature of the apparatus, it seems impracticable to extend the time of the test. Therefore to obtain the rates of sputtering at lower voltages a construction of the sputtering chamber has been achieved, which still allows weight determinations, and in addition permits light transmissivity measurements of sputtered deposits.

The determination of the rate of sputtering of a given substance is complicated in some instances by a copious secondary electron emission from the bombarded target. Thus the apparatus is used at present in a somewhat modified arrangement for study of this secondary electron emission from solid metals bombarded by argon ions.

GREGORY TIMOSHENKO.
Department of Electrical Engineering,
Massachusetts Institute of Technology.
April 20.

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[1] *Phys. Rev.*, **48**, 886 (1935).

[2] Seeliger and Sommermeyer, *Z. Phys.*, **98**, 692 (1935).

X-Ray Intensifying Screens adapted to Structure Analysis

THE intensifying screens in use for medical radiography cannot be employed to reduce times of exposure when working on tissue fibres, as they are not sensitive to the radiation used in structure analysis. However, Messrs. Ilford, Ltd., London, have now produced a screen, the Ilford Fluorazure intensifying screen (Levy-West), which proves to be very suitable for this purpose; this screen was put at our disposal by Mr. Chr. J. Bruno Wittgrefe, of the X-Ray Section, Ilford Co., to whom our best thanks are due for this kindness.

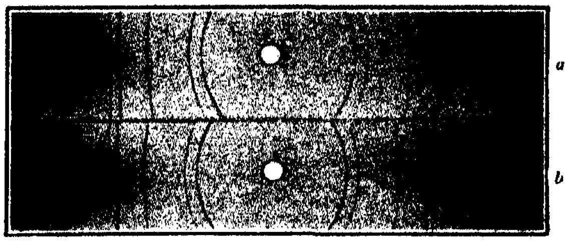

Fig. 1.

X-RAY PHOTOGRAPH OF A COPPER WIRE, TAKEN AT 40 KV. (*a*) ILFORD FILM WITHOUT SCREEN; EXPOSURE 45 MIN. (*b*) ILFORD FILM WITH A FLUORAZURE SCREEN AT THE BACK; EXPOSURE 15 MIN.

While we expected that increase of line width would counteract the advantages from eventual intensifying to such an extent that the photographs obtained would only be suitable for approximate work and not for exact measurements, we were quite astonished to find not only actual intensifying (3 times at 40 kV.) but moreover practically no increase of width, which seems a very important feature in the new screen. As appears from the photographs reproduced herewith (Fig. 1), it has proved possible to obtain films suitable for exact measurements. The photographs were taken with a Philips Metalix tube with copper-anticathode and a nickel filter of 0·01 mm. The Debye-Scherrer camera had a radius of 2·77 cm., while the diaphragm consisted of two pinholes 0·5 mm. diameter, separated by 6 cm. A copper wire of 0·6 mm. diameter was taken as a sample. Unless otherwise stated, the photographs were taken at 40 kV. and 15·5 m.amp.

First a photograph was taken on an Agfa-Laue film, the usual material for structure analysis. Proper blackening was obtained after 75 min. exposure. Then the experiment was repeated using an Ilford film. To get the same blackening as in the former case, an exposure of 45 min. proved to be necessary. The grain of the Ilford film is slightly coarser, but still within admissible limits (see Fig. 1, *a*). Thirdly, we made a photograph on an Ilford film on the back of which a Fluorazure screen (Levy-West) was placed (Fig. 1, *b*). Identical results were now obtained with exposure reduced to 15 min., while there appeared to be practically no increase of width.

While at the ends of Fig. 1, *a*, the subdivision into α_1 and α_2 lines is fairly visible, Fig. 1, *b* still gives some slight evidence of their presence.

Other experiments were made at 30 kV. with an Ilford film at the back of which was a Fluorazure screen; the exposure was 15 min. While giving better contrast, blackening proves to be less; so that here the disadvantage seems to outweigh the advantage.

As usual in medical radiology, we also placed screens in front of and at the back of the film, but this gave, as might be expected, less blackening in the same time than with a screen at the back only; moreover, increase of width becomes manifest in that case.

We suggest that the use of Fluorazure screens is helpful in structure analysis; especially with the long exposure necessary in fibre research, it has evident advantages. Meanwhile, further research is being conducted along these lines.

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April 14.

Living Animal Cases of Congenital Porphyrinuria

Some time ago, in a single herd of grade shorthorn cattle, running with one bull, on a farm in Swaziland, five living cases of congenital porphyrinuria were discovered. From the account given by the farmer, there had been seven other cases in the herd. Only one bull (a pure-bred, roan shorthorn) had been used during this period, and on an adjoining farm where he had also been employed, one case had occurred with certainty. The bull himself is normal but his dam was said to have been an unthrifty animal; possibly she, also, may have been a porphyrinuric.

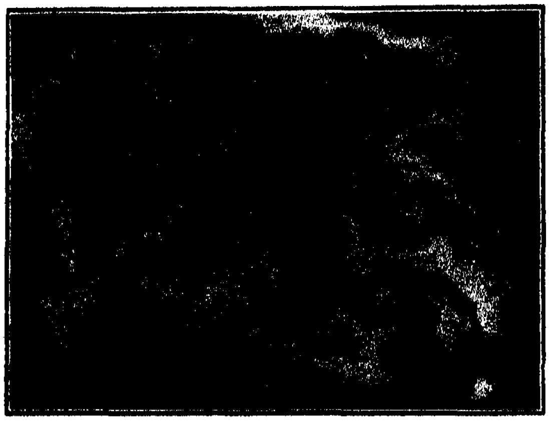

Fig. 1.

PHOTOSENSITIZATION LESIONS ON BACK OF 'CEDARA', A COW SUFFERING FROM CONGENITAL PORPHYRINURIA.

The bull, four of the affected cattle and others, most of which are descended from him but normal, have been acquired by this Laboratory with a view to intensive study of the clinical features of the disease and its mode of inheritance. The fifth affected animal was slaughtered and a detailed chemical investigation carried out *post mortem*. In the forthcoming number of the *Onderstepoort Journal of Veterinary Science* (7, No. 2) papers are contributed by the writers of this note describing in full their findings. The two most severely affected animals each excrete about 0·6 gm. coproporphyrin and 0·06–0·07 gm. uroporphyrin daily, the others about half these quantities only. They show signs of photosensitization.

We also wish to record that a female calf which suffers from the disease has now been born at the Laboratory. It was the progeny of the bull with one of his normal daughters. The animal was seen approximately two hours after its birth, and the teeth were then distinctly pinkish-brown in colour. It is red-coated and although small is not apparently seriously handicapped in any way. It passes about 7·7 mgm. coproporphyrin per 100 gm. dry weight of fæces and about 40 γ per 100 ml. in the urine. A second heifer calf, born on the same day, sired by the bull out of another normal daughter, is perfectly normal in every respect. It excretes 0·41 γ coproporphyrin per 100 ml. of urine and but traces, only recognizable fluoriscopically, in the fæces.

Yet another case has recently been discovered, quite unrelated to the herd described above. This is a black-and-white cow about eight years of age. She shows marked lesions of photosensitization, involving only the white areas of skin on the back (see Fig. 1). This cow is in calf to a normal bull. She has reared one calf previously (apparently normal) but has also aborted.

A histopathological study of the bones and organs taken from the porphyrinuric animal which was killed is being made with the aid of an ultra-violet fluorescence microscope, and these findings will be published shortly. The bones, it may be mentioned, show on cross-section annular zones of pigment of varying intensity.

We believe these to be the first living cases of porphyrinuria in animals ever to be described, and the wealth of our material makes it highly probable that by breeding experiments we may be able successfully to elucidate the mechanism of inheritance of this very rare metabolic anomaly.

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Sex-Biology of the Oyster and the Salmon

There are similarities in the sex-biology of the oyster, *O. edulis*, and the salmon, *Salmo salar*, which may prove to be fundamental in character.

It is known that very young salmon remain in fresh-water as parr a variable time. Very rapid growth in the first year of life is often followed by development of the sea-migratory instinct, when the young fish acquires the attributes of, and departs for the sea as, a smolt. On the other hand, slow-growing parr may remain in fresh-water two, three or four years[1].

Just as certain smolts become sexually mature after one year in the sea and return as grilse to fresh-water to spawn, so in certain warm seasons in England, and more frequently in warmer and more southerly latitudes, do oysters mature as females at an age of one year[2]. Other individuals of *Salmo salar* and others of *O. edulis* do not mature sexually until they are older, or rather other *O. edulis* certainly do not mature *as females* until they are older. In the case of this oyster there can be little doubt that environmental conditions govern the first onset of female sexual maturity, and it is considered a reasonable hypothesis to assume that the same conditions are operating on salmon.

In the oyster, all the factors operating in the attainment of sexual maturity at an age of one year are not known, but relatively high temperature (accompanied doubtless by a correlated type of metabolism), rapid feeding and rapid growth are known factors. But rapid feeding and growth result in the sea-migratory impulse in parr, and there are indications that the same factors may be operating in inducing sexual maturity in certain salmon after one year in the sea. It is known, however, that grilse are largely those fish which have had a long life as parr, and it is at this point where 'excess metabolism' or 'physiological repletion' does not quite account for the assumption of the sexual phase, as there appear to be good grounds for the deduction that younger fish may grow at a greater rate than grilse and yet not return to fresh-water to spawn. At least two primary factors are therefore involved: (1) relative adolescence and (2) rate—and perhaps nature—of metabolism.

The attainment of the adult organization in free-living animals may be presumed to be generally essential for the assumption of a preparation for female sexual maturity. In the oyster, again, it is stated that sexual maturity in a female may be delayed in colder localities until the animal is three years old[3], although the oysters at this age may be far bigger than the one-year-old females found in the warmer hydrographical localities.

It would seem that in these considerations may be found a solution of the problem of the varying ages of sexual maturity in the salmon and the oyster. Among invertebrates, growth in spring may be relatively great before larvæ are produced and a much larger size attained than in the summer broods[4], hence the temperature and rate at which good feeding occurs in these forms is more important for breeding than the amount of food consumed, and good growth may take place without the production of genital products. The oyster appears to conform to the same principle, but whether the same holds for the salmon must await further information. There is, however, nothing at variance with known biological phenomena in the possibility of homogenetic eggs from one salmon giving rise to smolts of different ages *and also* to either grilse or first spawning salmon of different ages.

The interesting facts regarding the high proportion of males among grilse, the change in proportion of grilse and salmon and the decline of grilse taken generally, are explicable on the varying opportunities smolt may have of feeding under different conditions in the sea. Loss of feeding grounds, for example, would entail a longer sojourn in the sea to build up the body requirements, so that the decline of hake, for example, *might* be correlated with the reduction in the proportion of grilse now taken; and in general, unknown fluctuations of salmon food in the sea may be related to fluctuations in the sea-life of smolts.

Fundamental researches on the biology of insignificant invertebrates may therefore reveal principles applicable to important food fishes such as salmon and—by a modification of the argument given above—also to herring.

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June 4.

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[2] Orton, J. H., NATURE, **139**, 108 (Jan. 16, 1937).

[3] Spärck, R., *Report Danish Biol. Station*, 30 (1924).

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Nocturnal Habits of *Platyedra gossypiella* Saunders

IN the course of investigational work on *Platyedra gossypiella*, the pink bollworm of cotton, in the West Indies, observations were made on its nocturnal habits, concerning which but little is known. On the question of light attraction, for example, there has been a stalemate of opinions. Wilcocks[1] in Egypt found that both sexes came to light readily; while Busck[2] in Hawaii states that the moth is not attracted to light "but is on the contrary shy of all light, natural and artificial". "The idea", he writes, "that moths were attracted to light is based on very unsatisfactory evidence and is probably due to a misidentification of material collected in the traps"! In St. Vincent, B.W.I., light attraction is evident from 8 p.m. to 4 a.m., when it fails rapidly. By 5 a.m., though it is still dark, the moths are hiding as by day. In Egypt, Ballou[3] found that there were always some moths that were not attracted. This difference has also been observed in St. Vincent and is not due to age, sex or condition. Attraction is strongest during the mating period. Wedded pairs are readily attracted, but in all cases prolonged exposure tires the response. There is no noticeable difference between the behaviour of long- and short-cycle moths.

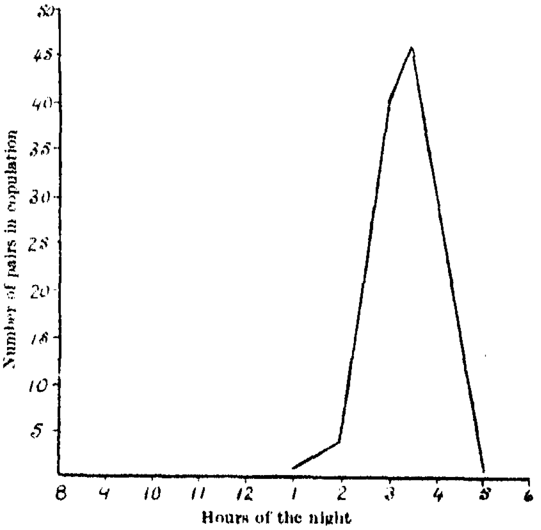

Fig. 1

Copulating moths take up the end-to-end position. Mating is curiously restricted to the last two hours of the active period (Fig. 1). The couples are docile and do not readily separate. Copulation takes place soon after emergence (Fig. 2), lasts for 1-2 hours, and is not repeated.

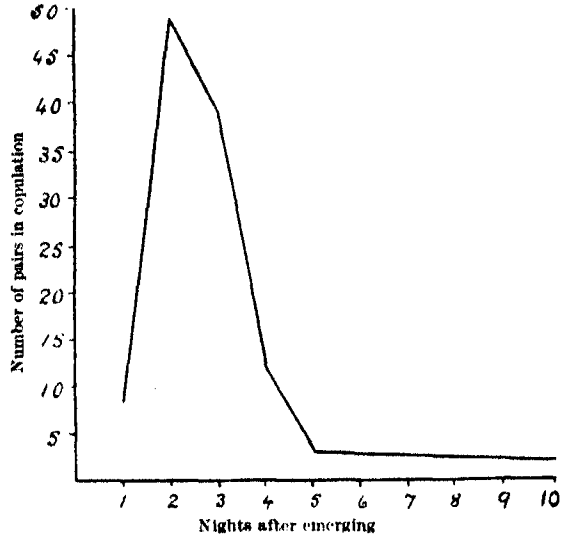

Fig. 2

The moths feed at all hours of the active period on sugar solution, fruit or on the secretion of the nectaries at the base of the cotton bolls. Oviposition, which usually commences on the third day after copulation, likewise takes place at any time of the night.

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[1] Wilcocks, F. C., "The Insect and Related Pests of Egypt Injurious to the Cotton Plant", Ministry of Agriculture, Egypt (1916).

[2] Busck, "The Pink Bollworm (*Pectinophora gossypiella*)", *J. Agric. Res.*, 9, No. 10 (1917).

[3] Ballou, H. A., "Cotton and the Pink Bollworm in Egypt", *West Indian Bull.*, 17, No. 1.

A Double Refraction Effect in Certain Fatty Materials

THE projection refractometer is particularly suitable for the examination of some doubly refracting materials, the properties of which do not appear to be widely known.

Certain fatty materials the refractive indexes of which are known have, in fact, two refractive indexes. On the ordinary refractometer in which the light is transmitted through the material to be tested, the border line of total reflection due to the higher index is not usually seen, since there is much greater contrast at the border line due to the lower index. The space between the two border lines is plane polarized, the vibrations taking place in a direction parallel to the border lines. Thus, these materials appear to behave as though they were doubly refracting.

It has been known for some years that soap gives these two border lines under certain conditions. Recently some other materials were investigated, and it was found that vaseline, lanoline, rubber lubricant, ordinary yellow soap, and the pure green soft soap, all give the two border lines referred to. On the other hand, various thick lubricants give only one border line.

It was found that vaseline, lanoline and the rubber lubricant, if melted and dripped on to the refractometer prism, give only one border line, that due to the lower index; but if the material is then smeared while it is still upon the prism, thus removing any possibility of micro-crystals being orientated in a particular direction, the second border line appears, and in the case of lanoline treated in this way, there is a trace of a third border line. In the case of moistened yellow soap, the difference in refractive index is about 50 per cent greater than the difference between the ordinary and extraordinary rays of quartz.

The projection refractometer has a single horizontal prism surface upon which material is placed. Light from an internal source is totally reflected at the interface of the prism and the material being tested. None of the materials mentioned above gives a sufficiently sharp border line to allow of readings closer than the third decimal place.

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Collision of Two Oil Drops and the Stability of a Non-spherical Oil Drop

IT has been found that the oil drops used in our investigation on the determination of the electronic charge show large variations in the time of descent, t_g, and ascent, t_{f-g}, with time, and consequently the greatest common divisor v_1. This is true of all oils experimented with, such as Apiezon *A* and *B*, Nye's superfine clock oil and others, except our newly prepared animal oil (which shows little or no change). Nevertheless, it makes necessary the careful study of the time variations of these three quantities. The results may be stated as follows:

There are four distinct classes of drops.

(1) 50 per cent of the total number are spherical drops which behave normally.

(2) With a few drops, collision of two unequal spheres forms a pear shape drop, showing very large

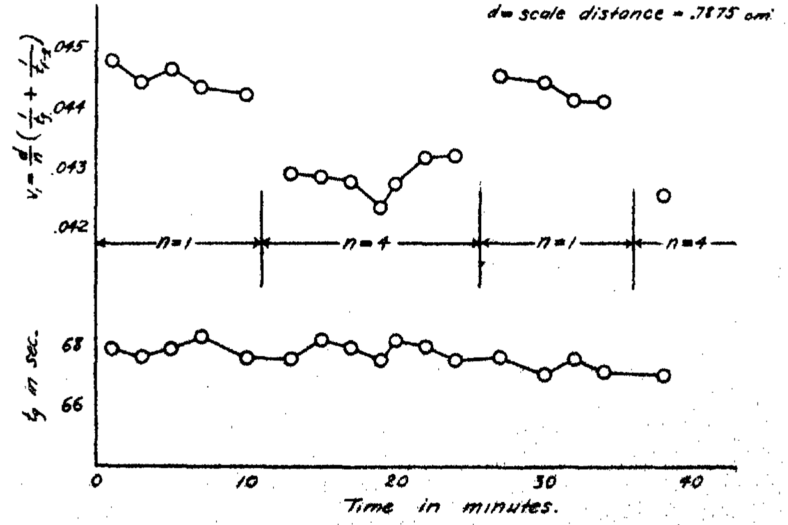

Fig. 1.

discontinuities in the curves. The resulting drop becomes a sphere within a short time.

(3) For 20 per cent of the drops t_g and t_{f-g} increase for the first five minutes at the same percentage rate. These drops are found to be oblate spheroids with eccentricity gradually decreasing with time, and becoming spheres.

(4) For 30 per cent of the drops, as shown in Fig. 1, while the time variation curve of t_g is very regular, that of the greatest common divisor v_1 shows discontinuities which depend upon the number of charges on the drop, and the greater the number the smaller the common divisor. This class of drop is stable for hours. They are presumably prolate spheroids.

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May 15.

Points from Foregoing Letters

THE heat conductivity of liquid helium II at 1·34° and 2·06° K. has been measured by Dr. J. F. Allen, Dr. R. Peierls and M. Zaki Uddin, by means of a new method consisting essentially of a combination of a vapour-pressure thermometer with a liquid-helium manometer. The results show that the heat conductivity of liquid helium II depends upon the temperature gradient, an unusual behaviour for which, the authors state, they can offer no explanation.

A convenient method of analysing ternary gas mixtures, containing hydrogen as one component, by means of thermal conductivity measurements, is described by J. L. Bolland and Dr. H. W. Melville. The volume of gas required may be reduced to 0·01 c.c. at N.T.P., by using a suitable micro-conductivity cell.

Photographs showing slip-formation in crystals of salt the surfaces of which have been scratched and then stretched, are submitted by A. W. Stepanow. The photographs, taken in polarized light, show that the surface scratches give rise to slips; these in turn increase the surface defect, which ends in fracture.

From the effect of iodoacetate, phloridzin and arsenate upon the lactic acid formation in muscle extract, Dr. Dorothy M. Needham and R. K. Pillai deduce that the oxidation-reduction of triosephosphate with pyruvic acid is coupled with a synthesis of adenylpyrophosphate from adenylic acid and free phosphate. They suggest that this coupled esterification of phosphate may play an important part during the anærobic recovery period in the muscle, when there is little heat output. The energy developed by the first reaction, they consider, may be taken up by the second.

A substance with absorption band at 639 mμ, which Dr. R. Lemberg, B. Cortis-Jones and M. Norrie recently deemed to be a hydrogen-peroxide compound of proto-hæmochromogen, appears, according to further tests by the same authors, to be the ferric hæmochromogen of an oxyporphyrin carrying a hydroxyl group on the α-methene group.

A graph showing the amount of hydrochloric acid taken up by powdered glass after given periods of time, and another giving the change in electric potential of a new glass electrode with time, are submitted by G. Haugaard. From these, the author infers that the suitability of a glass as an electrode depends upon its ability to exchange sodium and calcium ions for hydrogen ions, and that it should be possible to produce sodium and calcium electrodes by choosing a glass of proper composition or a mineral of the permutit type.

An apparatus has been built at the Massachusetts Institute of Technology by Dr. Gregory Timoshenko for studying controlled sputtering of metals under the impact of positive ions. The apparatus in its present form allows accurate measurements of the rates of sputtering and of secondary electron emission from various solid metals bombarded by argon ions having an energy of 6,000–2,000 volts.

Photographs are submitted by Dr. N. H. Kolkmeijer, C. J. Krom and H. Kunst to show the usefulness of the Ilford 'Fluorazure' screen in shortening the exposure time needed to obtain X-ray photographic patterns of fibres for the analysis of their structure.

Several cases of animals suffering from congenital porphyrinuria, a rare disease in which porphyrin (a red decomposition product of hæmatin, but containing no iron) is excreted, are described by P. J. Fourie and Dr. Claude Rimington. Some of the animals are living, and the authors hope, by means of breeding experiments, to elucidate the mechanism of this peculiar metabolic anomaly, which also renders the skin of the animals sensitive to light.

Prof. J. H. Orton finds that, in the oyster, environmental conditions (that is, higher temperature, rapid feeding and rapid growth) influence the first onset of female sexual maturity. He points out that similar conditions result in the sea-migratory impulse in parr (young salmon in fresh-water). The sexual maturity in salmon, which induces them to return from the sea to fresh-water, appears to depend both upon age and size, which is a factor of environment. This may explain the varying ages of sexual maturity in the salmon and the oyster.

The nocturnal mating habits of the pink bollworm of cotton (*Platyedra gossypiella*) are described by F. A. Squire. The author points out that the moths are attracted by light only during certain hours of the night, which may account for the divergence of opinion expressed on the subject by different observers.

L. Bellingham finds that vaseline, lanoline, rubber lubricant, and certain soaps, have two refractive indexes when tested by the projection refractometer. If melted and dripped on the refractometer prism, the lower index is observed, but if smeared upon the prism so as to prevent orientation, the higher index becomes effective.

During experiments on the fall of electrified oil drops (for the determination of the electronic charge), Y. Ishida has identified four types of drops, according to their shape and the variation in the time of their fall.

Research Items

Prehistoric Archæology of North-Eastern New Mexico

PROF. E. B. RENAUD, in his ninth report on the archæological survey of the High Western Plains, which he is carrying out on behalf of the University of Denver, deals with the north-eastern area of New Mexico, which has been visited in summer field-work on various occasions since 1930. For archæological purposes, the region has been divided into six districts covering the three areas of drainage—the Dry Cimmaron, the Canadian River, and the Pecos River. The region as a whole contains a large number of archæological sites, of which 211 have been reported. Of these, the most common is the camp site, but other indications of the presence of man are tipi rings, grinding stones, potsherds and factory sites. No less than 86 camp sites have been recorded. 'Scattered finds' number 67. An important but difficult source of material is the 'blow-out'—hollows in sandy soils and dunes caused by various agencies, natural and other, at the bottom of which archæological and sometimes palæontological material has collected. The region is of archæological importance as the peripheral area of two cultures, the Plains culture and the Pueblo. This is reflected in the pottery, which has been examined, classified and discussed in detail. The distinctive character of the two types and their subdivisions are clearly shown. The lithic industry, however, in this area is of more importance than the ceramic. Two successive cultural phases are distinguished—the Basket-makers and the Pueblo. Of the former, the earliest phase is the 'Fumarole' culture, first discovered by Prof. Renaud and Mr. H. J. Cook. The 'fumaroles' or mounds then examined were found to cover rock shelters. The stone implements from the 'fumaroles' fall into three classes. Of these, the largest and most important, constituting the true 'fumarole' industry, is of quartzite, flaked by percussion and Mousterian in appearance. This 'Fumarole' culture is clearly anterior to the Basket-makers of the caves of Oklahoma and New Mexico, and may represent the nomads who are postulated as preceding the true Basket-makers.

Longevity of Monkeys

Two aged macaques are described by Prof. W. C. Osman Hill, both of which lived in Ceylon (*Spolia Zeylanica*, **20**, Pt. 2, 255; 1937). One, a male toque macaque, *Macaca sinica*, was an experimental specimen of the Government Bacteriological Institute, Colombo, and had been used by Sir Aldo Castellani in his experiments on yaws which were published in 1907. It died on March 2, 1936, when it was known to be at least thirty years of age, and was probably thirty-five. Thus it exceeded the recorded age of any of its congeners, although the macaques are outstanding amongst monkeys on account of their length of life. The second specimen, a male Celebesian black macaque, *Macaca nigra*, was full-grown when purchased for the Trivandrum Zoo on June 15, 1907. It died in 1933 after twenty-six years of captivity, and must have been several years older. Flower states that the black ape seldom lives more than ten years in captivity; but gives two unusual examples of survival to fourteen and eighteen years—a limit considerably exceeded by the Trivandrum specimen.

Cheek Bones of Teleostomes

TAKING the sensory organs of the lateral line as a criterion, T. S. Westoll (*J. Anat.*, **71**, Pt. 3; 1937) has endeavoured to clear up the confusion that exists in regard to certain of the cheek bones in teleostome fishes. In recent years, it has been shown that the bone in the most primitive tetrapods which is homologous with the mammalian squamosal is associated with the horizontal part of the jugal canal. This provides a starting-point from which to work backwards to the fish. It is found that in the Choanata generally, allowing for modifications resulting from the adoption of different feeding habits, a squamosal bone can be recognized to be lost perhaps only in certain late dipnoans. On the other hand, in all known Actinopterygii the canal has degenerated, and in consequence the squamosal bone has disappeared.

Decapod Crustacea of Japan

A ZOOGEOGRAPHICAL survey of the decapod Crustacea of the Seas of Okhotsk and Japan carried out by Z. I. Kobjakova shows that in both areas boreal forms predominate to the extent of up to seventy per cent of all the decapod species occurring in the seas (*Trav. Soc. Nat. Leningrad*, **65**, 185; 1936). Next in order follow the arctic-boreal forms, followed by subtropical, and the poorest representation, particularly in the Japanese Sea, is of true arctic species. In this Sea there is no abyssal fauna, because of the shallowness of the straits, and the history of the Sea, which to the close of the Pliocene was an inland sea separated from the Pacific by a strip of land, is also that of a shallow basin the floor of which has sunk up to 4,000 metres only in recent times. The isolation from the Pacific accounts for the large number of endemic forms (21 per cent of Macrura), for the smaller number of Pacific forms, and partly for the influx in relatively large numbers (12·3 per cent) of typical southern sub-tropical and even tropical forms. The decapod fauna of the Japan Sea is richer (113 species) than that of the Sea of Okhotsk (81 species), but in the latter there is a true abyssal fauna derived from the Pacific Ocean; on the other hand, southern sub-tropical representatives are much fewer in number.

The Millipedes of India

No. 4 of vol. 11 of the *Memoirs of the Indian Museum* (1936) consists of a long memoir by Dr. C. Attems of Vienna on the Indian Diplopoda. Under the term "India" are included the whole of the Indian Peninsula, Ceylon, Burma, Indo-Chinese countries and China, excepting the Malay Peninsula. The author states that systematic and faunistic knowledge of the Indian Diplopoda is still very incomplete, and in fact we are only at the beginning of a faunistic explanation. In the present paper, 62 new species and 15 new genera are described. The most characteristic feature of this fauna is the great number of Sphaerotheridæ present, all the genera, excepting *Zephronia*, being endemic. Altogether, 290 species and subspecies of Diplopoda are known from the region dealt with and, excepting five, they are all endemic. Of the 92 Indian genera, 64, or nearly 70 per cent, are endemic. Only South India can be regarded as at all properly explored with reference to these animals, while China, with only 21 known species of Diplopoda, is least explored of all. Dr. Attems's contribution is likely to remain as the basis for the study of the oriental Diplopoda for many years and is, consequently, a work of importance to all students and workers on that class of myriapods.

Classification in the Amaryllidaceæ

THE four genera of the Amaryllidaceæ, *Zephyranthes*, *Pyrolirion*, *Hippeastrum* and *Habranthus* have been encumbered with a confused taxonomy for the last fifty years. Their numerous species have made an ever-increasing contribution to garden beauty, and it is therefore most fortunate that Mr. J. R. Sealy has recently reduced their classification to order (*J. Roy. Hort. Soc.*, **62**, Pt. 5; May 1937). Characters of the spathe, the andrœcium and the gynæceum, have confirmed Dean Herbert's original descriptions of the four genera in 1821, and discount more recent tendencies to include them in two groups. The outlook of the paper is that of a 'splitter', but the descriptions now given are exact and clearly defined. They should effect the exact correlation of the name of a plant species with its degree of beauty or utility, which is the necessary contribution of taxonomy to horticulture.

Rust-Resistant Antirrhinums

THE severe attack of antirrhinum plants by the rust-fungus *Puccinia antirrhini* in 1934, turned the attention of gardeners to possible methods of control. Mr. D. E. Green has shown that the fungus cannot reasonably be kept in check by fungicides, and he has recently described his trials with resistant plants (*J. Roy. Hort. Soc.*, **62**, Pt. 5; May 1937). A number of strains of the antirrhinum of American origin have been found to possess varying capacities for resisting attack by the rust fungus. The best of them is 62 per cent resistant; but resistance is not as yet combined with horticultural excellence. The attainment of such a combination presents the urgent problem of the future.

Gold in Plant Ash

AN announcement was made some time ago (B. Němec, *Ber. deutsch. bot. Gesell.*, **53**, 560; 1935) that traces of gold had been found in the ash of *Zea Mays* grains from plants grown in the Žitný Ostrov (the so-called Rye Island between the arms of the Danube in south Slovakia). Danube sand from this district is known to contain gold (about 0·1 gm. per ton) and plants are able to accumulate it. According to analyses, the metal concentrates in the seeds and fruit of flowering plants, whilst the whole plant of *Equisetum palustre* is found to accumulate gold to the extent of 610 gm. per ton of ash. It is found that the gold content is related to the silica content of the ash. Among the ashes examined the following percentages of gold were recorded:

Zea Mays (fruit)	0·00015–0·0002
Urtica dioica (plant)	0·00168
Datura Stramonium (fruit)	0·00202
Helianthus annuus	—
Mentha arvensis	0·030
Clematis vitalba (stem)	0·011
,, ,, (fruit)	0·06
Salix caprea (wood)	trace

Plants grown at other places where gold has been found were also found to contain recognizable amounts of the metal in the ash, but none was found in the same species grown where gold was known to be absent. The metal was first detected by its reaction with dimethylamino-benzylidene thiocyanate, and later some of it was actually isolated by reduction and fusion into an ingot. Prof. Němec, in collaboration with Drs. J. Babička and I. Smoler, on February 27, read before the Czech Academy of Sciences a paper on the spectroscopic identification of gold in these plant ashes and gave further chemical evidence of the accumulation of the metal in the ashes of many plants growing in auriferous soils. The spectrograms are said to confirm the presence of gold in those plants in which the metal was detected by chemical means.

Geological Aspects of Deep Drilling Problems

THERE are three main differences between drilling a deep well and an ordinary well to a depth of only two or three thousand feet: in a deep well, the distance between points of development and application of mechanical power is increased, and temperatures encountered are higher and pressures greater. W. E. V. Abraham, in a paper presented to the Burma Branch of the Institution of Petroleum Technologists on May 4, considered the geological aspect of these three differences. The increased length of transmission shaft is on the whole an engineering problem, though geological forecasts as to depths at which particular horizons will be met are correspondingly less certain at greater depths; the strata drilled through are liable to be harder, tougher and more compact, and coring is a more difficult operation at depth. A point of interest to the geologist is that the depth/temperature gradient varies in different places depending on the nature of the strata encountered, that is, whether folded, synclinal or anticlinal. Sufficient data are not, however, available for the formulation of any theory of temperature/gradient variation. Other problems resultant upon increased temperature are concerned chiefly with cementation and mud control, and do not therefore come within the purview of the geologist. Increased pressure with depth, however, concerns the geologist vitally, and the problem is no simple one, since it has been proved that as a general rule fluid pressures do not increase in accordance with the corresponding hydrostatic head, but in some cases, after a certain depth has been reached, are more than twice the corresponding hydrostatic head. Several theories have been advanced to account for abnormal pressures encountered at depth, all of which are based on the assumption that free movement of the fluid is in some way prevented, with the result that high pressures are incapable of dissipation. The most probable cause of such abnormal pressures seems, on the evidence now available, to be the weight of overlying strata.

Hydrography of the River Severn

THE flow of the River Severn during the fifteen years 1921–1936 was the subject of a paper read before the Institution of Civil Engineers on April 20 by Prof. S. M. Dixon, Mr. G. Fitzgibbon and Dr. M. A. Hogan and now published. The Severn was selected for the purpose of flow investigation because it was the only large river free from artificial controls and river traffic within convenient distance from London. The portion of the Severn Valley dealt with lies above Bewdley and has an area of 1,632 sq. miles. The present course of the river seems to be the result of glacial action, and there are indications that the pre-glacial valley ran northwards and is now covered by drift. It seems possible that a considerable quantity of water may be lost to the river by percolation along the direction of its old channel, particularly at low stages of flow. After discussing the selection of gauging stations, the methods of discharge-measurements and their accuracy, the paper (as reported in the *Journal of the Institution of Civil Engineers*, No. 7, 1936–37, June 1937) gives the results in graph form of 59 discharge measurements carried out during the years 1925–32 and one flood discharge in 1922. The largest discharge, 17,400 cusecs, was measured at the Elan Aqueduct bridge on December 11, 1929. Daily discharges for each of the fifteen years covered by the records have been plotted as hydrographs, of which five selected examples have been filed in the Institution library. Hydrographs of two floods (May 31–June 1, 1924 and February 16–22, 1928) are reproduced in the *Journal*. The difference between the average annual rainfall and the run-off (for the year commencing October 1) is 19·24 inches, or slightly more than half the rainfall. The largest loss, 23·80 inches, was in the year 1926–27, which had a high rainfall fairly evenly distributed throughout the year. The smallest loss was 13·63 inches in 1932–33, a year of low rainfall.

Borine Carbonyl

As is known, the simple hydride of boron, BH_3 (borine), has not been obtained, the simplest known hydride being diborane, B_2H_6. A. B. Burg and H. I. Schlesinger (*J. Amer. Chem. Soc.*, **59**, 780; 1937) find that a gaseous compound BH_3CO, which they call borine carbonyl, is obtained by the interaction of B_2H_6 with carbon monoxide in great excess and under pressure. The reaction reaches equilibrium rapidly at 100°; at room temperature the reaction is slow enough to permit the isolation of the product: $B_2H_6 + 2CO \rightleftharpoons 2BH_3CO$. The formula was checked by the vapour density. The rate of decomposition is held to suggest the transitory existence of molecules of borine, BH_3, but the isolation of the latter is not feasible. With ammonia, borine carbonyl forms a solid, stable at room temperature, having the empirical formula $BH_3CO(NH_3)_2$. Trimethylamine, on the other hand, rapidly and completely displaces carbon monoxide from the carbonyl at room temperature according to the equation $BH_3CO + (CH_3)_3N \rightarrow (CH_3)_3NBH_3 + CO$, which is held to justify the conclusion that the reaction $BH_3CO \rightleftharpoons BH_3 + CO$ is far more rapid than the association of borine to form diborane. It is suggested that in borine carbonyl the borine and carbon monoxide are joined by a co-ordinate link consisting of electrons furnished by the carbon monoxide. The compound $(CH_3)_3NBH_3$ is remarkably stable and can be heated for some hours at 125° without showing any change in physical properties.

Response of the Ear to a Phase Reversal

C. S. HALLPIKE, H. Hartridge and A. F. Rawdon-Smith (*Proc. Phys. Soc.*, **49**, 190) have studied the response of the mammalian ear to a sudden phase reversal in a sustained tone of sinusoidal wave-form. The tone was obtained from a photo-electric cell siren feeding an amplifier and loud-speaker, and an investigation with a piezo-electric microphone and cathode ray oscillograph showed that the phase reversal was present in the output from the loud-speaker. The effect of the phase reversal on a listener was that of a sudden temporary depression of the sound intensity, sometimes accompanied by a tap or thud. The tone was then led to the ear of a decerebrate cat, and electrodes were applied to the auditory tract. The electrical disturbances were amplified and recorded. The record shows, instead of the phase-change, a temporary fall in response, which indicates that the aural elements in which these auditory tract potentials originate must be regarded as resonant structures. The electrical potentials obtained from electrodes on the cochlea were, however, similar to those from the microphone, and showed the phase change. It appears that the cochlear response originates in structures different from those responsible for the auditory tract response.

Separation of the Rare Earths

THE difficult problem of the separation of the rare earths has recently been attacked by a different method, employing the principle of distribution. Fischer, Dietz, and Jübermann (*Naturwiss.*, **25**, 348; 1937) have found that it is possible to select liquids between which compounds of the rare earths will distribute themselves, and for pairs of which the distribution coefficients of the various rare earth elements are sufficiently different to enable a separation to be made. Thus, the halides of the rare earths will distribute themselves between water and organic liquids such as alcohols, ethers, and ketones, and the distribution coefficient is different for the compounds of different elements. By the addition of other substances to the system it is possible to alter the degree of separation. The difference in the distribution coefficient of the halides of two rare earth elements differing by unity in atomic number may be as great as 50 per cent, if suitable solvents and added substances are chosen. Automatic distribution fractionating apparatus may be employed, resulting in a much more rapid separation of the rare earths than can be accomplished by the tedious methods of fractional crystallization and precipitation.

A New Harmonic Analyser

THE problem of harmonic analysis arises in many connexions, and the labour of the arithmetical methods is such that several attempts to devise machines for the evaluation of Fourier coefficients have been made. An essential element of them all is, of course, some form of mechanical integrator. Henrici built several models, of which the last enables ten coefficients to be obtained in one operation, from a curve which is followed by a tracing point. A purely electrical instrument has been developed by Prof. Miles Walker and his collaborators which enables harmonics of a voltage or current wave to be separately determined; the integrator in this instrument is a watt-meter. A new instrument, designed by Mr. J. Harvey, of the Imperial College, made by Amsler, and of which an example has recently been added to the mathematical collection in the Science Museum, uses as the integrating device an ordinary planimeter wheel. The various harmonics are determined separately, each order by means of a separate, interchangeable pinion. Harvey's original model went only to the sixth order, but Messrs. Amsler, by added gearing, and without alteration of principle, have extended this number to ten (21 coefficients). With this instrument, results to an accuracy within 1 per cent can be obtained. The instrument can also be used to find areas and their first and second moments.

Development in International Geodesy*

By Dr. J. de Graaff Hunter, C.I.E., F.R.S.

THE increase in the scope of geodetic work accomplished in recent years and planned for the early future is remarkable. The fundamental problem of geodesy is the precise determination of the shape and dimensions of the earth, or what may be described otherwise either as the figure of the earth or the form of the geoid. When this is fully solved, benefits will accrue to geophysics as well as to geodesy.

In the nineteenth century, Colonel Clarke derived values of the elements of the terrestrial spheroid, first in 1866 and later in 1880. In 1866 Clarke used several meridian arcs, namely, Anglo-Gallic 39°–60° N., Russian 45°–70° N., Cape 34°–29° S., Peruvian 3°–0° S.; and both of Clarke's determinations are utilized in one or other of the great geodetic surveys. They may be considered as the best of those made simply from arcs of triangulation; but all such deductions are vitiated, more or less, by deviations of the vertical. In 1909 Hayford derived a new set of values from the triangulation of the United States, introducing the hypothesis of isostasy so as to avoid the effects of anomalous deviation of the vertical; and his figures were adopted by the International Union of Geodesy and Geophysics in 1924 at Madrid as defining the international spheroid.

Now we are entering a new era. The figure of the earth can be determined either from triangulation arcs or areas, or from gravity surveys; or from a combination of both. The greater the extent of the work of either kind, the higher is the precision which may be looked for in the results, which also become more detailed. In the first method, the weakness of determination has derived from the relatively small scope of the data. Thus Clarke's determination of 1866 was based on a few arcs of meridian of total amplitude less than 60°; while Hayford's determination rested on an area which is less than two per cent of the earth's surface. Later determinations from the gravity field have also suffered from incompleteness of data. It is in the direction of greater fulness of data that a remarkable change is taking place; and this change is rendered possible and being brought into being by the Union of Geodesy.

There are now triangulation projects of a very comprehensive nature. The first resolution adopted by the Union of Geodesy and Geophysics at Edinburgh contemplates the junction of European and American triangulation across Asia and the Bering Straits; for which collaboration of the U.S.S.R. in Asia, the U.S.A. in Alaska, and Canada is essential. This will lead to a longitudinal arc of no less than 316°, mostly about latitude 52°, from which it deviates for the Asia-America junction. Of this work, 188° have already been finished. There remains to be done 4,800 km. from Irkutsk to Bering, 1,400 km. thence to the Alaska-Canada border and 1,100 km. in Canada.

Work in the U.S.S.R. is proceeding apace, and a great grid of triangulation is rapidly spreading over all that territory. Not only will the work extend to Bering, but, within five years, I am informed, it will also reach the region of Tashkent and make strong connexion through an existent link with the system of triangulation of British India. A report (of Commission 18) was presented to the Union at Lisbon on the present state and future possibilities of extension towards Australia. Already continuous triangulation exists between India and Siam and thence with French triangulation in Indo-China; and only small gaps exist between the triangulations of Siam and Malaya (four triangles) and that of the Dutch East Indies (250 km.) which extends to Sumbawa in longitude 117° E. There are possibilities of extension thence to Australia.

Again, in Europe there is already connexion between the Arctic Ocean and Crete, where there is a sea-gap of 300 km. to the North African coast. A project for spanning this is envisaged in Resolution XIV. In this or some other way, continuity will be obtained with the meridian arc, Cape to Cairo. Of this latter, of amplitude 65°, more than 60 per cent is accomplished, the main gap of 18° being in the Anglo-Egyptian Sudan. The combined system will lead to a meridian arc of 105°.

Resolution I refers also to the junction of the two Americas. At present the North American system is continuous through Canada, U.S.A. and Mexico down to latitude 17° N.

It will be seen that these schemes will lead to the ultimate connexion of all the main land areas; and it is probable that a decade will see the linking of all the main land areas of the northern hemisphere. It is much to be desired that the African arc should also be completed by that time.

Now consider the gravity surveys. Here activity has been great during the last thirty years, and there are some thousands of reliable gravity stations in various parts of the world. In 1849 Stokes showed how the detailed form of the geoid could be expressed in terms of gravity values; but we are still not in a position to obtain a full solution by this means. This is because the distribution of stations is not complete. It is essential that all portions of the globe should have a certain minimum density of stations. Lack of this cannot be made up by much greater density in special regions. Efforts accordingly need to be co-ordinated. This is well recognized by the Association of Geodesy, and a commission to consider the matter of geoidal determination was formed at Edinburgh. Most of the work required for this end is to be done at sea, though there are also land areas, some difficult of access, which remain to be dealt with. Here again we may confidently expect the situation to develop in the course of a decade, so that it will be possible to make good use of Stokes's method. The best means of combining results of this kind with those based on triangulation requires study.

The position of geodesy will be entirely changed when all geodetic surveys are linked and their results expressible in correct relative terms; and this we now expect to be realized in a reasonably short time, owing to the co-ordinating activities of the Union of Geodesy.

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*Report presented at the General Assembly of the International Council of Scientific Unions on April 26–May 3.

Reduction of Fading in Radio Communication

It is now well known that part of the fading of signals experienced in radio communication is due to the variation of phase difference between the two or more sets of waves arriving at the receiver. These changes in phase difference arise in the course of transmission of the indirect waves through the ionosphere.

Two papers describing experiments demonstrating methods of reduction of this type of fading were presented early this year to the Wireless Section of the Institution of Electrical Engineers and are now available. The first paper, by Drs. A. L. Green and G. Builder, entitled "Control of Wireless Signal Variations", directs attention to the possibility, already known, of reducing variations in intensity of signals by combining the effects of two or more signals which have been transmitted on adjacent frequencies. After outlining the theory of the method, a description is given of experiments carried out between the University of Sydney and Liverpool, New South Wales, a distance of 25 km.

In this case, the fading was due to interference between the ground and ionospheric waves, and the curves accompanying the paper show that this fading could be considerably reduced by modulating the carrier wave at the transmitter, and integrating at the receiver the rectified current produced by the three sets of waves—carrier and two side-bands—so transmitted. The optimum effect is shown to be obtained when 100 per cent modulation is employed at a frequency dependent upon the path difference between the ground and ionospheric waves. A more complete control of the fading is obtained, however, if the carrier waves are suppressed, and only the two side-band waves are emitted at the transmitting station. Experiments carried out with this method have shown that fading, which under some conditions may be of the order of 85 per cent of the received signal amplitude, can be reduced to 5 per cent or less.

The second paper, entitled "Control of Phase Fading in Long-distance Radio Communication", by Drs. A. L. Green and O. O. Pulley, describes the extension of these experiments to greater distances. Measurements have been made at distances of 700 km. (Sydney–Melbourne) and 3,300 km. (Sydney–Perth) from the transmitter, and it was found that the phase fading was due to interference between two main ionospheric rays of comparable intensity. On account of the fact that the path of each of the ionospheric rays was subject to appreciable alteration during the day or night according as reflection takes place from the *E* or *F* region of the ionosphere, it was found desirable in these experiments to employ two modulation frequencies having a ratio of 3 : 1, the carrier wave being suppressed as previously described. The optimum control frequencies were found to be 200 and 600 cycles per second when the distance between transmitter and receiver was 700 km., whereas at 3,300 km. the best frequencies were 50 and 150 c.p.s.

The concluding portion of the first paper discusses briefly the possible application of these modulation methods of fading control to ionospheric research, to direction finding and to broadcast telegraphy and telephony. In connexion with telephony, it must be pointed out that the fading control does not apply directly to the audio-frequency components of the received waves, and a special additional modulation would be necessary to carry the intelligence. The possibility of the introduction of distortion would appear to make the application of the methods to high-fidelity broadcasting impracticable.

The investigations described in these papers formed part of the programme of the Australian Radio Research Board; in the absence of the authors, the papers were presented in London by Mr. J. A. Ratcliffe.

The Rehabilitation of British Agriculture

THE publication of the Minister of Agriculture's proposals for the assistance of agriculture in Great Britain gives greater pertinence to the three broadsheets on agriculture recently issued by Political and Economic Planning (P E P). These broadsheets have been prompted by the desire to stimulate better informed discussion and the elaboration of a constructive policy in accordance with the position of agriculture in the national economy.

The firstbroad sheet deals with the demands of agriculture and the difficulties encountered by the various approaches to a balanced view. The Free Trade, Protectionist, Defence, Consumer and Employment approach are all briefly reviewed, as are those based on nutrition, amenities, industry, land maintenance and ownership. The broadsheet suggests that the types of crop and livestock to be produced by British agriculture should be those which the country is naturally best fitted to produce in relation to other countries over a long period. Arrangements are necessary for the control of imports and for marketing the home output to smooth out fluctuations of supply and prevent sudden changes in prices. Subsidies or reliefs to agriculture are not objectionable in principle, provided they are open and under effective Parliamentary review and directed to the constructive development of permanent assets, not the bolstering up or development of production which is permanently uneconomic or tends to a retrograde type of farming. Great importance is attached to making British agriculture once more a flourishing industry by the achievement of superior competitive efficiency in supplying certain parts of the market. A thorough overhaul of agricultural production and marketing and of land management is required to be applied to technique in order to realize the advantages of a modern industrial structure. A parallel overhaul of country social and utility services is also required to counteract the rival attractions of factory employment and town social services.

In the second broadsheet the problem is approached from the consumer's point of view, and the need for further information about consumption habits in different areas and at different income levels as a basis for market policy is emphasized, as well as the importance of making the necessary economic adjustments to enable British agriculture to take advantage, so far as possible, of demand changes in its favour and to minimize the repercussions of other changes in demand. Needs in distribution are summarized as assembling and placing at the disposal of the consumer a suitable supply of the products demanded, at convenient times, at the lowest possible cost and at prices he can afford, and carrying out a large range of ancillary services such as delivery and credit. The value of concentrating demand where possible and of steady contracts is stressed, as well as the opportunities of developing rival industries, and the importance of efficient organization in the farming units if the good will and support of the urban electorate are to be held. The Marketing Boards have as yet scarcely touched the major problems with which they are confronted of expanding the market for home produce, increasing the return to the farmer, and reducing the cost to the consumer through savings in transport and distribution, or gaining for the farmer a larger share in the profits of processing his output or in reducing the contribution to the profit derived by supplying him with fertilizers, feeding stuffs and seeds.

The third broadsheet, dealing with the farm and of agriculture, emphasizes that the industry has far too many diverse elements and is affected by too many other activities at home and abroad for any one formula or panacea to offer a solution of its problems. Determined criticism of all one-sided approaches or ideas is indispensable. British agriculture is also regarded as having lost the close touch with the consumer demand which it had when the market was smaller and more static. The necessity for adapting agriculture as an industry in which the landowner and land agent, the farmer, agricultural engineer, the veterinary officer, marketing expert and other specialists can effectively work together is also stressed, as well as that of continuous local leadership. A stable rural basis for agriculture can no longer be assumed, and only an all-round policy of rural reconstruction can save British agriculture as a living and growing organism. Stable prosperity for farmers, it is suggested, can only be secured by types of farm and methods of farming designed to give the maximum net return each year over a long period. Agricultural subsidies and assistance should have for their objects urgent salvage or relief work of an essentially temporary nature for badly hit branches of the industry; permanent re-adjustment of the balance between town and country life, through subsidizing of rural roads, telephones and social services; and long-term development, such as improving farms and buildings, improving stock and eradicating disease, increasing the fertility of the soil, afforestation, land drainage, and information services. Particular stress is laid on the importance of increased expenditure on research.

Bantu Blood Groups

IN a comprehensive study of the blood groups of the Bantu of Southern Africa by Mr. Ronald Elsdon-Dew (*Pub. South African Inst. Med. Research*, 7, No. 39), a suggestion is made, based on this line of research, as to the early racial history of the African peoples.

Five thousand recruits for the Witwatersrand mines, grouped according to Bantu tribal origin, were submitted to the blood test. On this evidence it would appear that the Bantu are not homogeneous from a serological point of view; but as a whole they show a position close to the origin in the predominance of *O*, a position unoccupied except by such races as the American Indian, and indicating a more primitive distribution of the groups than is found in any other black race of which the figures are known. The known crosses of Caucasoid and Negro as exemplified in Algeria and Tunis occupy a position midway between the Caucasoid races and the origin. The Berber peoples show a small proportion of *B*, but they have a proportion of *A*, which gives them a type of distribution found in certain races separated early from the stock of mankind, such as the Australian aborigines. The Bush race shows a similar arrangement, while the Hottentot lies between the black races and the Egyptians.

The Southern Bantu are found to fall into three main groups, a primitive group, an intermediate group and a Caucasoid group. In the Caucasoid group fall the Mpondo and Xhosa. In comparison with other groups, this must have absorbed a considerable proportion of Caucasoid blood. The Bushman-Hottentot complex could have had this effect, and this agrees with the fact that Mpondo and Xhosa show culturally and linguistically the results of Bushman-Hottentot contact to a greater extent than is shown by the other races. The intermediate group comprises Zulu, Shangaan, Tswana and Southern Sotho, corresponding roughly to the Nguni group. The primitive group comprises on one hand the Tchopi and Inyambane, about whose separate entity there is no doubt, and on the other hand the Swazi and Northern Sotho, whose position needs further investigation with reference to the Bantu as a whole, and the alleged primitive black race. If, as is usually held, the Bantu is derived from a Negro stock with Caucasoid (Hamitic) admixture, it is remarkable that serologically it should be more primitive than the Negroes of West Africa, a fact which suggests to the author a revision of early African racial history.

At some early date Africa was inhabited only by a black race, probably living near the west coast, and composed solely of the *O* group, as *A* and *B* had not appeared at the time it separated from the main stock. Africa was then invaded by a light-skinned small race bearing the factors *B* and *A*, which moved south, forming the Bushmen. A taller, light-skinned race with the factors *O* and *A* then arrived, but remained in the north, forming the Berber race. Then came a race with all the blood-groups which spread all over Africa, pushing the Bushman south and giving rise to the Hottentots. The black race, still unaffected by *A* and *B*, moved south, following Bushmen and Hottentot and followed by other races with all the groups, who affected the black left behind in West Africa and the rearguard.

The Bantu are thus the result of the interactions between the Caucasoid and a primitive black race showing little or no *A* and *B*. Serologically they are more primitive than the Bushman, while if the Hottentot has had any effect it is only in recent times.

Excavations of the Egypt Exploration Society in Nubia, 1936-37

AN exhibition of archæological finds by expeditions sent out by the Egypt Exploration Society at Tell el-Amarna and Sesebi on the Upper Nile in Nubia in the season 1936-37 opened in the rooms of the Palestine Exploration Fund, 2 Hinde Street, Manchester Square, London, W.1, on July 5, and will remain open until July 24.

The excavations in Nubia, which have been carried out under the direction in the field of Prof. A. M. Blackman, were undertaken in view of the approaching termination of the Society's operations at Tell el-Amarna, and in the expectation of obtaining a view of the culture of that period at an angle differing from that of the Amarna evidence. Sulb and Sesebi, sites covered by the concession granted to the Society by the Government of the Anglo-Egyptian Sudan, have been known since 1908 to be associated with Akhenaten, when the late J. H. Breasted identified Sesebi with the Nubian Gem-Aten, and recognized that the founder of the temple there had been Akhenaten, and not, as previously supposed, Sethos I, who had covered the inscriptions of the earlier king with plaster and inscribed on them his own name and a rededication of the temple.

Although the official name of the city was doubtless changed after the time of Akhenaten, the former name must have been retained among the people, as it was still known by that name seven centuries later, when the god of the place was recorded as "Amun of Gem-Aten".

The temple was founded about 1370 B.C., before Amenophis IV had changed his name to Akhenaten, as is shown by the foundation deposits. This change took place about the fourth year of his reign, or at Sesebi, owing to its remote situation, perhaps a little later. Scarabs of Tethmosis III and Tethmosis IV from the cemetery suggest that Sesebi was an Egyptian settlement of some importance long before the accession of Amenophis IV.

The fortified town of Sesebi is situated between the Second and Third Cataracts of the Nile, about one hundred and eighty miles south of Halfa. The fortress, which lies about two hundred metres distant from the river on the west bank, enclosed an area of about two hundred and seventy metres long by about two hundred metres broad. Its crude brick walls are about 4·60 m. thick, and in some places still stand to a height of 4–5 m. The width of the buttresses is approximately 3·15 m. and they stand out 2·65 m. from the walls. In each of the four walls is a well-constructed gateway.

Within the walls, the most striking feature is a group of three temples, before excavation thought to be one only, erected on a single and unusually solid substructure, and extending along the western side of a forecourt, once enclosed in massive walls. Four sets of foundation deposits were found intact under the north-west and south-west corners of the substructure. They comprised among other relics two inscribed blue faience plaques and a large inscribed scarab of the same material, clearly showing that the foundation had taken place before the monarch's change of name. The full significance of this fact was brought out by reliefs on the walls of a subterranean crypt below the central temple, in which the king, sometimes with the queen, is represented seated in the company of various deities. The reliefs, therefore, belong to his polytheistic period, before he changed his religion to the monotheistic worship of the Aten. They are in the ordinary style of the Eighteenth Dynasty and not that of the Amarna period.

The crypt is in itself a remarkable discovery. It is the only known example of such a substructure at so early a date, preceding the well-known crypt of the Ptolemaic temple of Denderah by approximately thirteen hundred years.

What are conjectured to be portions of the sandstone façade of the temple, showing some highly finished reliefs, were found. Of these one shows the head of the goddess Hathor, while on another are the heads of two negro prisoners, possibly part of a much larger war relief, to which belonged a representation of the king slaying captives, not brought to England. The style of this block, with the strongly marked features and masterly line, closely resembles that of the magnificent scenes in the tomb of Horemheb. It is probably to be assigned to the end of the Eighteenth Dynasty. Mention may also be made here of a remarkable head of a granite statue of a king, or possibly of Queen Hatshepsut.

Outside the temple area an important find was a stone structure situated close to the north-east corner, which had undergone at least one reconstruction. In its original form it had been a small colonnaded open court on a stone platform about 11·70 m. square and two metres high. This had been the work of Akhenaten, and possibly was a small sun temple, a view supported by the unusual feature that it was approached by a ramp or stairway on the western side, which would enable the officiating priest to greet the rising sun on entering the temple at dawn.

Immediately south of the temple were found three rows of magazines, and south of these again the south-western portion of the residential area. In the magazines a doorjamb inscribed to a vizir of the reign of Amenophis II supports the earlier dating of the settlement.

Although the area of the town examined had been much disturbed, it produced a quantity of interesting material. It has been possible to make out the symmetrical rectangular planning of the streets, To the west of the town lies the New Kingdom cemetery, which seems to have been subjected to considerable depredation. Tombs had been plundered, re-used and plundered again. Nevertheless, it supplied a fine collection of scarabs and much pottery, as well as other objects. Three groups included bronze mirrors laid on the chest, one a very fine specimen, and with another was a bronze bowl. A remarkable example of fine work is a green felspar amulet in the form of a baboon with the moon-disk on its head, and probably from the same string was a *millefiore* bead in the original gold mount. In one tomb the face painted on the cartonnage has survived. One exhibit of no little interest, though late in date, is a human pelvis still wrapped in its leather loin-cloth.

Association of Technical Institutions

SUMMER MEETING AT BLACKPOOL

THE summer meeting of the Association of Technical Institutions was held at Blackpool on June 24–26.

Two reports having a direct bearing on policy were presented and discussed. The first was the report on policy in technical education, prepared by a joint committee of the Association of Technical Institutions, the Association of Principals of Technical Institutions, the Association of Teachers in Technical Institutions and the National Society of Art Masters. First published in 1932, this report has been twice revised, in 1934–35 and in the form presented to the recent Conference. Its field is wide and includes descriptions of the present system, courses of instruction, regional co-ordination of technical education, examinations, scholarships, libraries, staffing, technical education in small towns, buildings and equipment and social activities. The second report dealt with Education for Citizenship in Technical Institutions and is dealt with in the leading article in this issue of NATURE.

Of special and immediate interest was a paper on education in industrial management prepared by Mr. E. S. Byng, vice-chairman of Standard Telephones and Cables, Ltd., and Mr. G. A. Robinson, principal of the South-East London Technical Institute. This branch of education has grown considerably of late years both in Great Britain and in the United States, and its importance cannot be underestimated. As one expert has put it: "Such training was not to be a substitute for experience. . . . The growing complexity of industrial organizations, the evolution of new techniques, the application of science to industry, the growing size of business units and such items as industrial, economic and technological factors combine to make successful management far more complicated and difficult than it was in the past. Experience plus training are recognized in all professions civil and military. Is management the only profession where training is unnecessary?" The social significance of the subject was well expressed by the authors of the paper when they said: "One of the greatest services which education in regard to management could render would be to imbue the general body of workers with a sound elementary knowledge of the principles affecting the conditions, conduct and direction of the undertaking which they serve. In a democracy, an understanding of the principles by the workers would assist management, whereas in a dictatorship the conditions may be different."

The authors further brought out the vast increase in the number of persons who are now concerned in management. Modern manufacturing methods actually require a much larger proportion of administrative workers than was necessary under earlier conditions. In a typical engineering organization with approximately 10,000 employees, those engaged in one phase or other of management may represent as much as twenty-five per cent of the total staff. It is not to be wondered at, therefore, that many of those in control of industry feel the need for a constant supply of young men not only proficient in the technology of departmental functions, but also trained in the principles of administration. Appendices to the paper included a list of schools where instruction in management is given, and syllabuses of "Fundamentals of Industrial Administration", "Workshop Organization and Management", and "Works Supervisory Course".

Dr. E. Benson, headmaster of the Blackpool Grammar School, read a paper on "The Grammar Schools and Technical Education". He admitted that he approached the subject from the point of view of the grammar schools. During the discussion, it was made clear that technical educationists, while differing sometimes with the educational views put forward by those connected with grammar schools, have no quarrel with grammar schools and their work as such. At the same time, they spoke their minds with some freedom when they thought the grammar schools were claiming a kind of monopoly in educational powers. Dr. Benson quoted Sir Josiah Stamp's saying that education to-day might be considered to have three main objects. It trains individuals to get a living, to live a life and to mould a world—in other words, it is education for work, leisure and responsibility. Dr. Benson's claim that the grammar school "does its best to give this complete education" may be true; but there are not lacking many who would challenge it. Neither are there lacking many who would demand to hear much more argument before they could be convinced that none of the types of post-primary schools "has succeeded so far in sharing with the grammar schools the most important of the vital qualities which the grammar schools possess. . . ." The same people would probably think that Dr. Benson had only appreciated a part of the work when to that remark he added ". . . except that junior technical schools, especially in conjunction with senior technical institutions, have, although they are comparatively few in number, established high standards for example in accuracy and craftsmanship".

University Events

BIRMINGHAM.—At the annual degree congregation held on July 3, the Chancellor (Viscount Cecil of Chelwood) conferred the honorary degree of LL.D. on the following: The Right Hon. Lord Austin, Sir Harry Gilbert Barling, Mr. Edward Cadbury, The Right Hon. Sir Wilfrid Arthur Greene, and Sir Percival Perry. The honorary degree of D.Sc. was conferred on Mr. C. C. Paterson.

The ordinary degree of D.Sc. was conferred on D. A. Howes for a treatise on "The Principles of Motor Fuel Preparation" (in collaboration with Prof. A. W. Nash) and for a paper on "The Use of Synthetic Methanol as a Motor Fuel" and other papers on allied subjects (*J. Inst. Pet. Tech.*, *J. Soc. Chem. Ind.* and elsewhere).

The degree of M.D. (*ex officio*) was conferred on Prof. H. P. Newsholme.

CAMBRIDGE.—Dr. A. D. Thackeray, of King's College, has been appointed assistant director of the Solar Physics Observatory for five years from July 1.

An appointment to a research studentship at Christ's College will be made at the end of July 1938. Candidates must be men who will have graduated before October 1, 1938, at some University other than Cambridge, and they must be not more than twenty-six years of age on that date. Preference will be given to those who have already devoted at least a year to research. Further information can be obtained from the Master, Christ's College, Cambridge. Detailed information about the admission of research students to the University will be found in the "Student's Handbook to the University of Cambridge", published annually by the Cambridge University Press. It may be estimated that the total annual expenses, including vacations, of a research student at Cambridge, is about £350 a year.

Sir David Chadwick has been elected to an honorary fellowship at Sidney Sussex College, not at Christ's College, as stated in NATURE of July 3, p. 38.

EDINBURGH.—At a graduation ceremonial on July 2 the honorary degree of LL.D. was conferred on the following, among others: Prof. L. H. Baekeland, hon. professor of chemical engineering, Columbia University, New York; Sir William Bragg; Dr. N. M. Butler, president of Columbia University, New York; Sir Herbert Grierson, rector of the University; Dr. Alexander Morgan.

The Principal, Sir Thomas Holland, referred to the sense of loss felt by the University on the death of its Chancellor, Sir James Barrie, who in a letter written only three days before he was taken seriously ill, had expressed his intention of presiding at that graduation. It was at a similar ceremonial, as the Principal recalled, that Barrie was 'capped' fifty-five years ago.

ST. ANDREWS.—It has been decided to confer the honorary degree of LL.D. on the following: Prof. G. F. Stout, professor of logic and metaphysics in the University from 1903 until 1936, and Dr. W. T. Calman, president of the Linnean Society, lately keeper of the Zoology Department, British Museum (Natural History).

Science News a Century Ago

Mushet's Discovery of Blackband Ironstone

DAVID MUSHET (1772–1847) was among the foremost metallurgists of his day, and besides contributing articles on iron manufacturing to the "Encyclopædia Britannica" and "Rees' Cyclopædia", he contributed some thirty papers to the *Philosophical Transactions*. On July 12, 1837, he wrote a letter from Coleford, Gloucestershire, to the editor of the *Scotsman*, in which there had been a communication on the iron trade of Scotland and the blackband ironstone. In this letter he said: "As this ironstone has now become an object of considerable national importance, perhaps you will allow me room to allude more particularly to the circumstances of its discovery. Thirty-six years ago this summer, in attempting to cross the river Calder on foot, in the Old Monkland Parishes, I obtained nearly a dry footing upon what appeared to be a continuous black pavement, from the upper edge of which I struck off a piece of substance resembling coal, which upon closer examination, was found interlaminated with yolks of brownish matter, about three-eighths of an inch in thickness. These when separated from the carboniferous schist, proved to be good ironstone, but so small in quantity, that the average of the mass did not exceed 13 per cent. Next day I returned to the black pavement, better prepared to ascertain its extent and thickness. On removing a portion of the entire bed, I found it to be fourteen inches in thickness, viz., three and a half of coaly schist with the before-mentioned yolks, and ten and a half of more compact and solid matter. . . . In a short time from making this discovery I had ascertained the existence of the Blackband in 2,000 acres of land, including the Airdrie estate (for right of working in which, to a limited extent, £12,000 a year is now to be given) and determined it to be a regular member of the coal formation. . . ."

Advancement of Medical Science

AN editorial article in the *British Annals of Medicine* of July 14, 1837, contains the following passage: "Reform in institutions is advancement in the sciences, and the latter is not the least deserving attention at the present time. Our practice is based on physiological indications, and much of the current physiology is false; in this country it is not yet on a line with the actual state of the science. We have too much metaphysical reasoning *about* functions and *about* diseases, too little systematic observation. . . Could not the Association encourage the invention of some systematic form by which the observations of a great number of members may be collected and compared? If we are to believe a contemporary, Dr. Haviland rebuked the College of Physicians in very elegant Latinity—not for their scientific apathy, not even for forgetting their mathematics, or for not applying them to vital phenomena but for selecting fellows unversed in Latin and Greek Better things may have been expected from Dr Haviland, but it is as difficult for an Oxford and Cambridge professor as for an Irvingite to raise his thoughts above the 'tongues'. The University of London will, we understand, reduce languages to their subordinate place as instruments in the general scheme of education."

Thomas Graham at University College, London

On July 15, 1837, the *Mechanics' Magazine* said: "The Chemical Chair of the London University College, vacant through the lamented demise of Professor Turner, has been conferred on Mr. Graham, the Andersonian Professor of Chemistry at Glasgow. A better selection could scarcely have been made. Mr. Graham was first made favourably known to chemical philosophers by his discovery of the laws of gaseous diffusion. He established by well-devised experiments, the conformity of gases flowing through minute orifices, to the universal physical law that determines the issuing velocities of non-elastic fluids. During the last five years he has been diligently engaged in elaborate inquiries into the constitution of salts, with special reference to the functions of their watery element, and has already published some results that are considered by good judges to affect materially the higher doctrines of chemical philosophy."

Medical Schools in Russia

The issue of the *London Medical Gazette* of July 15, 1837, contains the following account of the contemporary medical schools in Russia: "There are three principal universities in Russia proper, those of Moscow, Harkoff and St. Petersburg; and each of these universities has a large school of medicine. Those of Moscow and St. Petersburg are the most considerable, but there is still a good school at Harkoff, situated in the southern part of the empire, and destined for the convenience of the nations of the conquered provinces on the Asiatic borders. Each university which has a faculty of medicine has also an institute of medicine of the same kind; the students who attend the latter are educated at the expense of the Government, and are subsequently obliged to serve six years, at least, in the civil or military service. Although the first rudiments of a medical school at St. Petersburg are to be found in the establishment of the naval school by Peter the Great in the year 1715, yet the merit of organizing a medical faculty is due to Catherine the Second. In 1764 the Empress founded a medical college which with but few alterations from its first instalment is still recognized in the Medico-Chirurgical Academy of St. Petersburg. To the jurisdiction of this institution were subjected then, as at present, all the medical institutes and all medical practitioners, with the exception of court physicians, in the Empire."

Ploughing by Steam

The issue of the *Gentleman's Mazagine* of July 1837 contains the following announcement: "A very successful and interesting exhibition of ploughing by steam, invented by Mr. Parkes, took place at Red Moss, near Horwich, Lancashire. The engine is not locomotive, but remains stationary while the plough is at work. The plough is set in motion by means of two long, flexible belts of iron, revolving round two wheels attached to the engine, and round another wheel in a frame firmly fixed on the moss, at such a distance from the engine as may be proposed to make the furrow. The ends of these belts are fixed to the two ends of the plough, and pull it to and fro, for it does not turn in working, but cuts a furrow both when it recedes from and returns to the engine. This operation is most satisfactory, the plough turning a furrow eighteen inches broad, nine inches thick, and more than 300 yards long in less than four minutes.

Societies and Academies

Dublin

Royal Irish Academy, April 12.

P. G. Gormley: The zeros of Legendre functions. The number of zeros of the function $Qn^m(z)$, n and m being real, is determined by considering the change in phase due to a complete circuit round the plane, the number which are situated on each axis being given. Those zeros of the function $Pn^m(z)$ which lie to the right of the imaginary axis are considered.

A. C. Forbes: Some climatic theories in connexion with tree remains in and under peat. The stump layers in lowland bogs, which various observers from Geikie onwards have attributed to secular changes in rainfall, merely represent vegetative features in the development of marsh peat. They are the remains of trees which originated, matured and died on a saturated or water-logged substratum induced by topographic features, and neither normal nor periodic fluctuations in rainfall could have affected them to any material extent as is shown by their characteristic root development. The stump remains under mountain (soligenous) peat represent the final generations of pine and birch which gradually disappeared at high elevations, resulting in forest being replaced by peat, which, in its turn, is disappearing above 2,000 feet or so. These changes must be correlated with lower temperatures during the growing season, and the general tendency during the last 2,000 or 3,000 years in the British Isles has apparently been in the direction of cooler and moister summers and milder winters, and the altitudinal tree limit during that period has been lowered to about 1,000 feet. The rainfall and temperature conditions for peat formation are still in operation at the lower levels, and these do not differ in any important respect from those necessary for forest growth.

Paris

Academy of Sciences, May 19 (*C.R.*, **204**, 1449-1516)

Jules Drach: The logical integration of linear differential equations.

Nicolas Kryloff and Nicolas Bogolioùboff: The orgodic properties of series of probabilities *en chaine*.

Szolem Mandelbrojt: A general theorem furnishing the argument of singular points situated on the circle of convergence of a Taylor's series.

Jacques Hadamard: Remarks on the preceding note.

Raoul Goudey: Measurements of the intensity of gravity in France during the year 1936. Results for the values of g at fifty stations in France carried out with the Holweck-Lejay instrument.

Victor Volkoviski: Vortices in bands in liquids.

André Guilbert: The elementary expression of the energy affecting a magnetic particle of very small dimensions in a magnetizing field.

Raymond Hocart and Maurice Fallot: The identification of various phases by magnetic study and by the X-rays in alloys of iron and palladium. The magnetic study showed two phases the approximate composition of which are FePd and $FePd_3$, and these were confirmed by the X-rays. The phases only appear after prolonged annealing.

Boris Vodar: The absorption spectrum of nitric oxide (NO) in the liquid state.

Mlle. Milka Radoïtchitch: The influence of the solvent on the absorption spectra of neodymium acetylacetonate. Summary of results obtained with

39 organic solvents. Neither the dielectric constant nor the electric moment afford an explanation of the results. These intervene, but there are other factors which complicate the comparisons.

Mme. Niuta Winter-Klein : The relation which exists between the temperature of transformation and the variation of the (refractive) index for several kinds of glass.

W. Broniewski and I. St. Glotz : The physical and mechanical properties of pure iron as a function of the cold hardening.

Louis Hackspill and André Borocco : Compounds of the isotope 2 of hydrogen with the alkali metals (alkaline deuterides). The alkaline deuterides can be obtained by synthesis under the same conditions as the hydrides, their formulæ are analogous with the latter, and their appearance is the same.

Martin Battegay and Pierre Boehler : The anthrylisothiocyanates, anthrothiazols and mercaptoanthrothiazols.

Marcel Frèrejacque : Acetylglucosides of amines and rotary power.

Raymond Paul and Henri Normant : The action of furfuryl bromide on sodium phenate, *o*-furfurylphenol and furfuryloxybenzene.

R. Truhaut : Study of the compounds of glycocol and of alanine with mercuric oxide.

Louis Longchambon : The pyrogenation of coal. Studies of the coefficient of expansion of coal at temperatures below the coking temperature.

André Demay : The age of the metamorphism in the Central Massif.

Maurice Breistroffer : The fossiliferous levels of the Albian in the Vocontian abyss (Drôme, Hautes-Alpes and Basse-Alpes).

Charles Bois : The determination of the focal depth of very distant earthquakes.

A. Demolon and E. Bastisse : Observations in lysimetric boxes on the mobilization of the nitrogen and mineral reserves of the soil.

Stéphane Hénin : Asymmetry and the orientation of clay particles.

William Henri Schopfer and Albert Jung : The action of the products of disintegration of aneurine on Phycomyces. The second growth-factor of the Mucorineæ.

Mme. Andrée Drilhon : Study of the mineral exchanges in the homeiosmotic fishes.

Mlle. M. Hamon : The mechanisms producing dehiscence of the spermatophores of *Eupagurus Brideauxi.*

Basile Luyet : The mechanism of cellular death produced by high pressures : the cytological modifications accompanying death in yeast.

Robert Paulais : Copper, zinc and cobalt in the organs of Lamellibranch molluscs.

André Lwoff and Mme. Marguerite Lwoff : The function of hæmin, growth factor for *Hemiphilus influenzæ.*

Léon Binet, Georges Weller and Charles Jaulmes : The antitoxic power of glutathion. Researches on cobra poison.

Moscow

Academy of Sciences (*C.R.*, 14, No. 6 ; 1937).

S. Bernstein : The Cotes and the Tchebycheff formulæ of quadrature.

Ervin Feldheim : Mode of convergence in the interpolation of Lagrange.

N. A. Slioskin : Oscillations in rotation of a sphere filled by a viscous liquid.

V. V. Čelincev : Structure of organo-magnesium complexes.

N. A. Orlov and A. T. Shalygin : Preparation of carbohydrates by auto-oxidation of some hydrocarbons.

A. G. Bergman : Discovery of boron in Central Asia.

S. A. Borovik : (1) Finds of tin in micas. (2) Spectroscopic determination of rare earth elements in some minerals found in the U.S.S.R.

V. Smirnov and N. Aidinjan : Determination of ferrous oxide in rocks and minerals.

A. P. Vinogradov : Manganese in insects (Formicidæ). The problem of the chemical composition of organisms as a specific character.

A. P. Vinogradov, V. V. Danilova and L. S. Selivanov : Fluorine content of the rivers of the Union (in connexion with the occurrence of mottled enamel tooth disease).

I. A. Smorodincev and A. M. Feldt : Critical survey of methods of the separation of thyroglobulin.

I. A. Smorodincev and S. P. Bystrov : Influence of freezing on the swelling of meat.

E. V. Pavlovskij : New data on the stratigraphy of Cambrian deposits in the Lake Baikal region.

Šafranovskij : Distribution of angular values in crystals.

M. S. Loicjanskaja : The first stages of the decomposition of cellulose by *Spirochaeta cytophaga.*

D. Novogrudskij, E. Berezova, M. Nachimovskaja and M. Perviakova : Influence of bacterization of flax seed on the susceptibility of seedlings to infection with parasitic fungi.

E. D. Buslova : A contribution to a method of cultivating embryos of higher plants, deprived of the nutritive reserves of the seed.

K. T. Suchorukov and K. E. Ovčarov : The nature of immunity to rust.

A. A. Isakova and A. Smirnova : Influence of various microbe complexes of bacteriorhizas on the development of higher plants.

A. G. Tomilin : Observations on Far Eastern whales.

A. A. Voitkevič : The anterior lobes of the hypophysis and growth and differentiation phenomena in amphibians (1) and (2).

G. Streich and E. Svetozarov : The morphogenetic role of the thyroid in the process of feather formation.

Moscow

Academy of Sciences (*C.R.*, 14, No. 7 ; 1937).

N. Achyeser and B. Lewitan : Application of the inequality of H. Bohr and I. Favard.

V. Fabrikant, F. Butajeva and I. Cirg : The absolute concentration of excited atoms in a low-pressure mercury discharge.

M. Veingerov : A radiometer of low inertia based on the principle of gas thermometer.

L. Kibel : Mathematical theory of front shifting in the atmosphere.

S. J. Turlygin : Biological effect of centimetre waves.

N. N. Malov : The law of nervous excitation by alternating currents.

I. Leontjev and K. Markova : The curve of the 'racemization' of proteins from the muscles of certain invertebrates.

J. V. RAKITIN: Absorber for acetic aldehyde determination.

G. D. PRATASENJA: Production of polyploid plants after regeneration (2). Autotetraploid of *Nicotiana glauca*.

D. KOSTOFF: Studies on polyploid plants (16). *Nicotiana rustica* and *Nicotiana tabacum* amphidiploid.

E. S. SAPRYGINA: Vernalization of wheat hybrids of the first generation.

A. A. ISAKOVA: The true influence of bacteriorhizal micro-organisms on the germination of seeds (2).

A. V. IVANOV: A new ectoparasitic mollusc of the genus *Megadenus* Rosen.

T. A. BEDNJAKOVA: Induction of the infundibulum by the anterior end of the chorda.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 189–250, April).

C. E. NURNBERGER: Ionization theory and radiobiological phenomena. Assuming that hydrogen is the chief absorber in biological materials of neutrons, the ejected protons are the cause of the major part of the ionization. The concentration of ions produced by protons, and also by α-particles, is more than a hundred times that produced by electrons, and irradiation of aqueous solutions of tyrosine with X-rays (Stenstrom and Lohmann) and with α-particles gives results supporting the view that the chemical changes produced depend on ionic concentration. The relation of this work to recent investigations of the 'selective effect' of neutron irradiation of tissues is discussed.

A. A. BLESS: Effects of the length of X-ray waves on seeds. For moderate dosage, two minutes' exposure gives optimum growth at one stage, while at a later stage, optimum growth is produced by a different exposure. Over the range 0·6–0·12 A., the effects seem to be independent of wave-length.

M. MUSKAT and E. HUTCHISSON: Symmetry of the transmission coefficients for the passage of particles through potential barriers. A general wave-mechanical proof.

P. W. BRIDGMAN: Polymorphic transitions of inorganic compounds to 50,000 kgm./cm.^{2}. Thirty-five, out of eighty-five, such substances show polymorphism, and the transition parameters (pressure, temperature, change of volume and latent heat) have been determined. The temperature range of the experiments was − 79° C. to 200° C. The ice-type of transition (stable phase at higher temperature has the smaller volume) tends to become more common at high pressures. Latent heat shows no statistical trend with increasing pressure, but the energy change tends to increase proportionally with pressure, leading to the view that the atoms *increase* in size on passing to the high-pressure form. This suggests that an important fraction of the electrons of the high-pressure form are in an essentially different state from that in the free atoms.

G. H. PARKER: Colour changes due to erythrophores in the squirrel fish, *Holocentrus*. This fish changes from red to white in about 6 sec., and from white back to red in about 19 sec., on transfer from a black-walled illuminated vessel to a white-walled one or the reverse, due to expansion or contraction of red pigment in the erythrophores. Cutting through nerves supplying the skin suggests the existence of dispersing and concentrating nerves; the latter, at least, are activated by a neurohumor soluble in lipoids.

F. B. SUMNER and P. DOUDOROFF: Some quantitative relations between visual stimuli and the production or destruction of melanin in fishes. Colour adjustment of fishes and amphibians to background depends on (1) dispersion or concentration of pigment in chromatophores (rapid), (2) changes in amount of pigment (slow). This paper deals with the latter. Fish were placed in two series of four tanks painted white, grey, dark grey and black respectively, one set being illuminated by two 200-watt lamps, the other by two 10-watt lamps. After 87 days, the melanin contents of fish from each tank was estimated photometrically.

R. GOLDSCHMIDT: A remarkable parallelism. In investigating the mutant 'vestigial' in *Drosophila* and its series of multiple alleles, it has been found possible to arrange them in a series with increasing degeneration of wing tissue. It is thought that the genes control the production of a growth-promoting substance, and that the different alleles produce an insufficiency which, below a certain threshold, causes degeneration. Representing the data graphically, the curves produced are identical with those of Krueger on the relationship of bacteria and phage, indicating that the kinetics of the two processes are the same.

E. W. SINNOTT: The relation of gene to character in quantitative inheritance. If the distribution as to a given quantitative trait in an F_2 population is symmetrical, it is concluded that each gene makes a constant absolute contribution and that the contributions are cumulative; if, on the other hand, the distribution is skewed, this is considered as evidence that the genes are interacting and producing a geometric or multiplicative effect. Experimental work on fruit size in *Cucurbita Pepo* favours the latter view.

S. HECHT: The instantaneous visual threshold after light adaptation. In 1918, J. Blanchard published data on these thresholds. The eye was adapted to a given intensity by looking at a large illuminated area. At a given moment the adapting light was cut off and the minimum illumination required to make visible a central area at the same moment was determined. These data can be explained on the duplicity theory (cones functioning at high intensity and rods at low intensity), and numerical details of the data conform to the mathematical predictions of a photoreceptor process consisting of (*a*) a primary photochemical reaction whereby a photosensitive material is converted into active products, (*b*) a primary dark reaction maintaining the supply of photosensitive material, (*c*) a secondary dark reaction in which products of (*a*) undergo a change providing an impulse to the attached nerve.

G. A. MILLER: The groups of order p^m which have $m - 1$ independent generators.

R. BRAUER and C. NESBITT: Regular representations of algebras.

N. JACOBSON: Simple Lie algebras of type A.

D. V. WIDDER: The iterated Stieltjes transform.

K. MENGER: Metric methods in calculus of variations.

S. PASTERNACK: The mean value of r^s for Keplerian systems: a correction.

Forthcoming Events

Informal Conference on "Conduction of Electricity in Solids", July 13–16.—Arranged by the Physical Society and the University of Bristol, to be held in the H. H. Wills Physical Laboratory, University of Bristol.

Tuesday, July 13

Society for the Study of Inebriety, at 4—(at 11 Chandos Street, Cavendish Square, W.1).—Mrs. Lillias M. Blackett Jeffries: "Marriage in Relation to Alcohol and Drug Addiction".

Wednesday, July 14

British Academy, at 5.—Dr. Paul Schrecker: "Leibniz: with Special Reference to his Views on International Relations".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Engineer at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (quote J. 37/10) (July 12).

Lecturer in Mining in the Chesterfield Technical College—The Clerk to the Governors (July 14).

Lecturer in Electrical Engineering in Armstrong College, Newcastle-upon-Tyne—The Registrar (July 15).

Lecturer in Mechanical Engineering in the Northampton Polytechnic, St. John Street, E.C.1—The Principal (July 16).

Research Chemist with the Bone Research Association—Prof. W. A. Bone, Imperial College, South Kensington, S.W.7 (July 16).

Lecturer in Veterinary Pharmacology, Lecturer in Veterinary Parasitology, and Lecturer in Anatomy of Domesticated Animals in the Department of Agriculture, I.F.S.—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 16).

Lecturer in Mathematics and Lecturer in Chemistry in the Kingston Technical College—The Principal (July 17).

Assistants (grade III) in the Signals Experimental Establishment, Woolwich, S.E.18—The Superintendent (July 19).

Lecturer in Chemistry in the University of Birmingham—The Secretary (July 21).

Assistant Chemist in the Biochemistry Section of East Malling Research Station, Kent—The Secretary (June 28).

Director of the All-India Institute of Hygiene and Public Health, Calcutta—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (July 24).

Principal of the South-West Technical College, Walthamstow—The Director of Education, County Offices, Chelmsford (July 24).

Lecturer in Horticulture and Nature Study in the Stranmillis Training College, Belfast—The Principal (July 29).

Geologists in the Geological Survey of Great Britain and Museum of Practical Geology, Exhibition Road, South Kensington, S.W.7—The Director (July 31).

Structural Engineering Draughtsmen in H.M. Office of Works—The Chief Architect (Ref. G. W. Strent), Room 131A, iv. Flr., H.M. Office of Works, Storey's Gate, S.W.1.

Lecturer in Chemistry in the Brighton Technical College—The Education Officer, Education Offices, 54 Old Steine, Brighton 1.

Head of the Mechanical Engineering Department in the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon.

Official Publications Received

Great Britain and Ireland

University of Reading: National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1936. Pp. 78. (Shinfield: National Institute for Research in Dairying.) [26

Statistical Year Book 1937 of the International Tin Research and Development Council. Pp. 206. (London: International Tin Research and Development Council.) 6*s*. [36

P E P (Political and Economic Planning). Report on International Trade: a Survey of Problems affecting the Expansion of International Trade, with Proposals for the Development of British Commercial Policy and Export Mechanism. Pp. vii+302. (London: P E P.) Paper boards, 8*s*. 6*d*. net; cloth, 12*s*. 6*d*. net. [86

Joint Board of Research for Mental Disease: City and University of Birmingham. Annual Report, 1936–37. Pp. 15. (Birmingham: University of Birmingham.) [86

Other Countries

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 16, 1934. iv. Meteorologiska iakttagelser i Sverige, Band 76. Pp. x+107. 7.00 kr. vii. Meteorologiska iakttagelser i Riksgränsen. Pp. ii+40. 4.00 kr. Meddelanden, Band 6, No. 5: Meteorological Observations at Mount Nordenskiöld, Spitzbergen, during the International Polar Year 1932–1933. By Hilding Olsson. Pp. vii+83. 3.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [36

Université de Paris: Faculté des Sciences. Institut de Physique du Globe: L'Observatoire géophysique de Chambon-la-Forêt. Pp. 19. (Paris: Université de Paris.) [36

Pennsylvania State College: School of Agriculture and Experiment Station. Bulletin 339: The Digestibility of Rations by Cattle and Sheep. By Ernest B. Forbes, John W. Bratzler, Alex Black and Winfred W. Braman. Pp. 30. (State College, Pa.: Pennsylvania State College.) [46

United States National Museum. Bulletin 167: Life Histories of North American Birds of Prey. Order Falconiformes (Part 1). By Arthur Cleveland Bent. Pp. viii+409+102 plates. (Washington, D.C.: Government Printing Office.) 70 cents. [46

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Educational Equipment for the New Age

THE address on the university in civic training, which General Smuts delivered at his installation as Chancellor of the University of Cape Town on March 2, did not receive the attention it deserved outside South Africa. It dealt with a theme which has recurred in many speeches since it was stressed by Sir James Barrett and others at the celebrations of the centenary of the University of London last year, and at the Conference on Academic Freedom at Oxford in 1935. The function of the university, General Smuts insisted, is not merely to give its students a professional qualification ; it is to impart the ideals of citizenship and to fit its graduates spiritually into the world in which they had not merely to earn their living but also to play their part worthily. The university must teach the humanities—the things which furnish the student with the larger human equipment for life.

University and humanity together should form the keynote and essence of university culture, and it is in their absence that we suffer from excessive specialization and the narrow outlook responsible for so much mischief and suffering in the world to-day. Universality in its nature implies freedom from the prejudices which arise from ignorance or narrowness of outlook ; it means also an impartiality, a willingness to learn and a curiosity to understand whatever life may hold for us. No less than the ordinary citizen does the university student need to avoid a single-track mentality, and his university training should give him above all a vision of harmony in the universe, of the principles of order and beauty, which should remain with him as the most satisfying and outstanding experience of his life. Science, philosophy, poetry, religion can all help to clarify and deepen that experience.

The greatest lesson that science can teach us, General Smuts urged, is respect for facts ; and in the present-day tendency to follow slogans or catchwords, to worship ideologies or exalt party politics unduly, a disinterested loyalty to facts is the sovereign remedy. Equally important with this impartial spirit of science is the urbane generous spirit of humanity ; and General Smuts believes that the hostility of rival fascist and communist systems to the principles of racial, religious and political toleration is a passing phase, a symptom of the confusion and unrest of the times. He urged that South Africa, more than any other country in the world, is a great human laboratory, where experiments in racial co-operation are essential to success.

If it is difficult for European onlookers to feel as confident as General Smuts of either fascism or communism learning the grace of toleration or respect for facts, his plea for universality and humanism undoubtedly will meet with a widespread response. Its force was undoubtedly recognized, for example, in the discussions at the symposium on the chemist in industry in Manchester last April, where the need for a wide outlook and high ideals, as well as technical or professional efficiency, was stressed by Prof. J. C. Philip. Here again the evils of over-specialization were discussed, though it was pointed out by Mr. F. Scholefield that this danger does not lie in the kind of subject chosen for special study, and that men can be trained for a specific technical occupation, without incurring this evil, if the training is given on right lines.

That these dangers should be recognized is all to the good, but the discussion referred to, at which much was said about the qualifications of the chemist for administrative posts, scarcely stressed sufficiently the social responsibilities of industrial management at the present time. The growing tendency for industrial efficiency to be considered not merely in terms of dividend-earning capacity or mechanical efficiency but also in relation to industrial welfare and service to the community, enhances the importance of industrial leadership having not merely high ideals and wide sympathies but also some real understanding of social problems. The industrial leader must have the wisdom of a good citizen.

The special responsibilities of the universities in this matter have been frankly recognized of late. They were stressed in the report of the University Grants Committee as well as at the Quinquennial Congress of the Universities of the Empire at Cambridge last July, and the part which the universities have played in the social surveys of the Special Areas as well as the expansion, for example, of the Economics Research Section of the University of Manchester, indicates a desire to make a practical contribution to social science and the solution of social problems on a growing scale.

Important as are these practical studies and investigations, the fundamental problem for the universities in this matter is that to which General Smuts directs attention and on which Sir Ernest Simon challenged them in an address at Cardiff last year. If the universities adequately fill their function of providing leaders and citizens who will give a wise lead to their fellows in the effort needed to eliminate weak spots in our public life and to build a better social order, the redistribution of effort in scientific research or its initiation in new fields will follow. Moreover, effective leadership in a democracy demands a measure of co-operation and understanding from its ordinary citizens which in turn requires far higher intellectual qualities than in the authoritarian State, and here again the university has responsibilities scarcely less important than in the provision of leaders.

The two problems are in fact inextricably linked. Unless the university can provide democracy with leaders capable of taking wide and disinterested views and forming sound judgments in public affairs, and of clear and critical thinking, and able to use the appropriate scientific method of thought in the complex affairs of human society, the challenge of the authoritarian State to-day can scarcely be met. Equally the university cannot be expected to provide such leaders unless the students entering its doors have received a sufficiently wide general training in human and cultural subjects for the university to impart that stimulation and enrichment of the whole mind, independent of any specialized study the student pursues, which enable him to lead a fuller and more interesting human life and to play more adequately his part as a member of the community. Again, unless the training of the ordinary citizen in general science, in social subjects and in public affairs is wide enough to fit him to take disinterested views, to form sound judgments and to recognize and prefer wisdom and integrity in public representatives to the arts of the humbug and the demagogue, even if the supply of competent leaders is adequate, their selection by a democracy is not assured.

The heart of the problem lies accordingly in the pre-university training, especially in the post-primary or secondary school. Only as this is adequate and broad enough can the universities fulfil their own special functions of providing men and women, not merely skilled in some special subject or branch of knowledge but distinguished by a sense of values, a wide outlook, moral courage and a capacity for creative thought which, when ripened by experience, can be at the service of the community in any of the problems with which they may be confronted in their professional, industrial or civic life.

The question of training the university graduate for participation in public affairs cannot therefore be seriously considered apart from the question of educating the community as a whole. Sir Ernest Simon's insistence that the inefficiency of transfer of training implies that citizenship cannot be taught incidentally or indirectly, but that it can only be learnt by the direct study of the thought and life and actions of men in society, while undoubtedly right, should not lead us into any attempt to graft a special course of training in citizenship into the existing curricula of universities. The basic knowledge in these matters must be acquired at school. The university may incidentally extend that knowledge in certain subjects, but its main function here must be to supply the corrective to specialization, to quicken interest in human, social and cultural values, to inspire a vision of life as a whole, and to send out its graduates with a real interest in the affairs of the world, with a standard of values, a capacity for thinking clearly and some knowledge of the more difficult aspects of the problems of citizenship.

None the less, the university has certain special responsibilities in this field. In the first place, the need for developing some effective corrective to the present excessive and premature specialization is urgent and long overdue. Society cannot afford to wait until the universities are receiving students much more adequately prepared. Internal measures in the universities themselves are undoubtedly called for, even if only as temporary expedients.

In the second place, the influence which the universities exercise on secondary school teaching and curricula, if only through the scholarship system, is enormous. That influence could easily be exerted to repress the premature and disastrous specialization which often takes place in the later years at school. To require that a candidate for a university scholarship in some special subject such as history, classics or a science should attain a high standard in general subjects or even, as Sir Arthur Salter suggests, that any candidate for a degree should be required at some stage in his career to pass an examination in some aspect of the social sciences, might well be decisive. Merely to raise the age of the school-leaving examinations or matriculation so that they become, as they already are in Scotland, actual school-leaving examinations or entrance examinations to a university, might also assist to crush out the deplorable specialization of immature minds at school responsible for some of the most untoward results of the present system.

If, for these reasons, the initiative must largely lie with the universities, there are still other responsibilities in this field which they must accept. We are not concerned only with the students of the future or even with those at present in residence. It is equally important to touch those who have completed their courses and now fill all types of posts in industry or the professions, in some of which they have already assumed responsibilities of leadership. Only as they are awakened to the opportunities which confront them and come to recognize the duties and responsibilities of citizenship can we hope to make democracy safe against its present dangers.

This, of course, is not a task for the universities alone. There is an ample field for the activities of the Association for Education in Citizenship; and the recent conference arranged by this Association at Ashridge on the "Challenge to Democracy" affords an admirable example of what is wanted. A panel of outstanding speakers was drawn from all shades of political opinion, and, excluding party politics, they discussed the clash of ideas between dictators and democrats from the point of view of believers in the ultimate value of the full and free development of each individual citizen. The first half of the programme was concerned with the essentials of democracy; the second with the formation of public opinion, including the schools, the universities, the Press and adult education. Such a conference can scarcely fail to have a powerful effect in stimulating clear thinking on everyday affairs, and the vision and moral determination essential as preludes to the action and perpetual vigilance in defence of democracy, which alone can preserve for us in these threatening days mankind's rich intellectual heritage and freedom of thought and speech.

An Inquiry into "Marvels"

A Book of Marvels

By Lieut.-Comdr. Rupert T. Gould. (The Fountain Library.) Pp. ix+180. (London: Methuen and Co., Ltd., 1937.) 2*s*. 6*d*. net.

THIS book is mainly a survey of records of certain phenomena occurring between 20 B.C. and A.D. 1890 which, after sifting and weighing the available evidence, the author deems worthy of the designation "marvels". Some, however, may think the book scarcely bears out its title; indeed, the author himself, in the majority of his collected cases, carefully refrains from divulging his own views—if any were held—concerning the real significance of his "marvels". These may be summarized as follows:

(1) A line of foot-prints in the snow seen in Devon in 1855 which passed through—so it was said—locked gardens and over very high walls, haystacks, and roofs of houses, as though such things constituted no impedimenta. The impressions, which were in single file, were variously ascribed to a kangaroo, an otter, a badger, a donkey, a swan, and the Devil. Sir Richard Owen's opinion that the marks were made by a badger is discounted by Commander Gould on the score that, though Owen was an eminent palæontologist, he was given to "making dogmatic assertions,

in defiance of fact, which proved him to be possessed of a singular and not entirely scientific type of mind". For example, he insisted that the hippocampus major is the exclusive prerogative of the human brain whereas, as proved by Sir W. Flower and Huxley, it is a structure man shares with the apes; moreover, did not Owen also—and this is where the gallant Commander's sea-boot pinches—in "his utterly childish 'explanation' of the sea-serpent seen by H.M.S. *Daedalus* in 1848" postulate that the naval officers who saw it "were, one and all, half-witted"!

(2) Movements, by unknown agents, of coffins in sealed-up vaults. Floods admittedly entered some of these vaults, robbers broke into others, while yet others were in an area of occasional seismic disturbances. In 1899 Alfred Russel Wallace quoted Dale Owen's account of the coffin movements at Arensberg as "the best evidence as to occurrences which were, and are, wholly inexplicable". The value of this particular evidence may be gauged from the fact that the account was given to Dale Owen in 1859 (fifteen years after the alleged movements) by people who had only troubled to visit the vaults some considerable time after they had heard that certain individuals reported "groans" coming from the cemetery. Commander Gould admits that the evidence in this case was at third hand, and even so by a person with very little capacity for assessing its value; yet in the same breath he maintains that in the case of certain other coffin movements the disturbing agent "was neither human nor natural".

(3) The next "marvel" is an alleged power to sense (*nauscopie*) the approach of ships far below the horizon—sometimes three or four days' run distant. As the principal 'wizard' in these feats attributed his successes—there were also misfires—to careful observations of high-level atmospheric changes induced by the presence of the vessels beneath, further comments are needless.

(4) We are then reminded of the giants with which hearsay has peopled the earth since the days of the tales of Titan and Typhon, but whose outward and visible signs have invariably turned out to be either the skeletal remains of mammoth or other large lower animals or, where actually seen in the flesh, victims of ill-balanced endocrine glands.

(5) Acoustic mysteries, such as the ringing of bells in houses by undiscovered agents, and the hammer-like sounds alleged to have been emitted by Memnon at Thebes and heard by various celebrities between 20 B.C. and A.D. 190, since which date there has been silence. In the author's opinion, unequal expansion of the materials of the Colossus was the probable cause of the sounds.

(6) The most interesting part of the book is undoubtedly the account of some experiments carried out by Captain W. E. Parry in 1822 to determine the velocity of sound. At Winter's Island, with thermometer showing -25° F., and the barometer 28·84 inches, fifteen rounds were fired from a six-pounder gun at an angle of elevation of 10°, the times of flash and report being recorded by observers 5,645 ft. distant. The mean of these gave a velocity of 1,023 ft. per sec. What perplexed Parry, however, was that the order 'Fire!' sometimes reached the observer about half a second *after* the gun's report. Commander Gould endorses an explanation of this anomaly which was sent him by a correspondent, namely, that as the velocity of sound increases with increase of temperature, the word 'Fire!', travelling over a slightly colder route nearer the ice, reached the observers after the report of the gun which, in consequence of the 10° elevation, passed through a higher and slightly warmer air route. This explanation, in view of what must have been a very slight difference of temperature (t) of the two converging sound paths, seems to the reviewer far-fetched, especially in the light of the formula $v = 1093\sqrt{1+0{\cdot}00366\,t}$. It has been shown by many experiments that the velocity of the compression wave of sound increases with its intensity, a violent noise actually travelling faster than a gentle one. Jacques, for example, found that the sound emitted by the explosion of half a pound of gunpowder travelled at 1,032 ft. per sec., while that from 1½ pounds had a velocity of 1,187 ft. per sec. Surely this principle better explains the anomaly referred to by Gould. Other acoustic mysteries alluded to are distant cannon-like rumblings occasionally heard in mountainous regions. Colonel Godwin Austen, whose name is immortalized in the 28,265 feet high Himalayan peak, heard them when surveying in 1865. Similar sounds are also heard off the Belgian coast where, says Gould, they are locally known as 'fog-hiccups'.

The book concludes with *pro* and *con* arguments concerning the presence of canals in Mars.

These chapters, which must have involved a considerable amount of diligent delving into ancient records, savour in the majority of cases of much ado about nothing. We are surrounded by marvels; they make contact with us every day of our lives. How do radiation waves, from the fifteen-mile-long Hertzian, to the twenty million millionth of an inch cosmic waves, make their way through a *vacuum*? What is the secret of 'action at a distance', and how does an apple fall to the ground? What are 'energy' and 'matter', how are they mutually convertible, and how does the brain, as a synthesized aggregation of their fundamentals—photons, electrons and protons—feel, think, and—marvel? Here, indeed, are matters worthy of wonder, real marvels which put the mysterious pullings of bell-wires and movements of coffins in their proper perspective. Hearsay statements concerning events the causes of which were not ascertained, especially when made by credulous people with a mystical bent, though not necessarily devoid of truth, are always suspect. Science has carried all before it in virtue of two golden rules, the one, to "take no man's word for it", the other to be economical in assumptions in accordance with the Law of Parsimony that causes are not to be multiplied beyond mental necessity—*Entia non sunt multiplicanda praeter necessitatem*.

CHARLES M. BEADNELL.

A Compilation on Migrations

The Wandering Spirit:
a Study of Human Migration. By Dr. Ragnar Numelin. Pp. xvi + 375. (London: Macmillan and Co., Ltd., 1937.) 20*s*. net.

IN his attempt to analyse the conditions and stimuli underlying human migrations, Dr. Numelin has cast his net over the entire world, and has considered human movements from Palæolithic times down to the present day. But, although his many citations show that the physical and social conditions promoting migration are very complex, his methods and criteria are too vague to yield satisfactory results.

Despite his strictures on their loose use by others, the author uses terms like migration, wandering and nomadism without clear distinction, and he often fails to discriminate between seasonal movements of all or part of a community within its territory and group migration from one territory to another. Much of the movement among food-gathering peoples, of which he cites many examples, is in its seasonal and cyclic character to be distinguished clearly from large-scale displacements under pressure of food shortage or human enemies, and the author does not seem to have considered the evidence for territorial fixation among these peoples. This confusion of seasonal movements and journeying with migration in the sense of permanent displacement also leads him to regard fishing peoples as more migratory than primitive collecting and hunting groups. There is much evidence from western North America and north-eastern Asia, not mentioned by Dr. Numelin, which suggests that the contrary is more generally true.

Although a great deal of material is brought together in this volume, the use of sources is often very uncritical. The author frequently omits to mention or consider much recent work on peoples discussed, while general statements and assumptions of earlier writers are accepted as definitive. Assuming that remote linguistic relationships imply tribal migration between particular areas, he reaches improbable conclusions which are supported by no real evidence. The Iroquois, for example, are described as having migrated as coherent tribal groups from country west of the Mississippi, and the Navajo are brought to New Mexico from Alaska!

Dr. Numelin accepts creation myths as evidence of the origin and course of migrations of particular peoples, citing with approval for the Pueblo area the conclusions of Fewkes which, as later workers have shown, reduced the theory of historical migrations to absurdity. On the other hand, he does not refer to the more recent studies of Pueblo society by Kroeber, Parsons, and others, in which observed processes of fission and migration have been analysed. He gives numerous references to pilgrimages, trade journeys, and shifting of house and village site after death or pestilence, but does not discuss either the cumulative effects of such practices or their relation to group migration.

Although the discussion of "subsistence—geographical" conditions of migration, that is, the relation between the economy and the physical conditions at a particular place and time, is in general more satisfactory, and there are useful summaries of material on transhumance and other forms of seasonal migration in Europe, the evaluation of social and physiographical factors is rarely adequate. The author occasionally lapses into crude determinism. He refers frequently to mental qualities and uses the misleading term 'instinct', but does not present either a clear statement or cogent evidence concerning the part played by psychological factors.

This laborious piece of work has unfortunately been undertaken without either a clear formulation of the problems to be investigated or an adequate knowledge of recent methods and results in social anthropology. Dr. Numelin has not been very happily guided by those who revised his English text, for the writing is often unidiomatic, and his meaning is sometimes quite obscure.

DARYLL FORDE.

Epilogue to the Mendeléeff Centenary in Russia

Travaux du Congrès Jubilaire Mendeléev
Vol. 1. Pp. v+660+16 plates. Vol. 2. Pp. iv+471+10 plates. (Moscow et Leningrad: Académie des Sciences de l'URSS, 1936 and 1937.) 32+17 roubles.

THE Mendeléeff centenary congress held in Leningrad during September 1934 was described directly afterwards in NATURE (134, 799; 1934). The official report has just appeared.

The first volume contains the speeches of the Russian organizers and foreign guests, and all the lectures delivered in Leningrad. It is obviously intended for readers both in Russia and abroad; all the official Russian speeches are here followed by French versions, Russian lectures by translations into French or German, while lectures given in either of these languages—English was not used at the congress—are rendered into Russian also. There is no need to give a list of the speakers and their subjects, as these are already mentioned in the article in NATURE referred to above. Those lectures dealing with modern scientific questions have lost something of their topical interest through the long delay, though the various historical contributions are scarcely affected by the two years' procrastination.

Most of the foreign delegates to the congress were unable to follow the Russian speeches. While probably they were all impressed by the picturesque welcome offered by the delegation of Moscow chemical workmen, only now can they realize that the address spoken by their representative was one of the most significant delivered at the opening meeting, giving an account of the development of the Russian chemical industry; and that Prof. Nametkin's lecture traces in a most interesting manner Mendeléeff's endeavour to promote the petroleum industry in Russia. Those of Mendeléeff's admirers who had so far venerated him only as an investigator will be glad to learn how energetically he used his influence to direct this industry in the way he thought best for the benefit of his country.

The lectures delivered during the less formal continuation of the celebrations in Moscow; a few more already held in February 1934 at a meeting of the Russian Academy; and several papers which were only presented in manuscript and not read, form the subject of the second volume. The contributions by the Russian men of science frequently throw illuminating sidelights on Mendeléeff's rich and unconventional personality; Prof. S. I. Vavilov, in a paper on the importance of physics in Mendeléeff's scientific activities, incidentally mentions that his various interests, and their simultaneity, are reflected in his private library: it contains many books, bound by himself, which unite in the same volume novels with chemical and mathematical papers.

Some of the authors have taken the opportunity of extending their addresses. Prof. Wilh. Palmaer (Stockholm) presents in no less than fifty pages a survey of his own and his co-workers researches on the corrosion of metals; two excellent plates in colour illustrate his descriptions. In a few other cases one may be inclined to regret that the authors have strictly confined themselves to their spoken addresses; if, for example, Prof. W. Noddack (Freiburg) in his remarks on the Periodic System criticizes the evidence brought forward by some investigators for the existence of the elements 61, 85 and 87, readers may ask whether the proof which he himself offered so early as 1925 for the discovery of element 43 (masurium) is any more valid; as no confirmation has been forthcoming, it might be advisable to extend his well-founded scepticism also to this place of the Periodic System.

The delay in publication is probably due to an endeavour to produce a technically faultless book, and it must be acknowledged that the two stately volumes show none of those shortcomings in paper or print so frequently met with in Russian publications. This excellent typographic achievement and the great care devoted to the German and French texts and translations deserve high praise; although they may not always be linguistically quite correct, it is very remarkable that the Russian printers and proof-readers are able to produce such long and difficult treatises practically free from misprints in foreign languages.

At the end of the second part the names of the ten honorary presidents—the list being headed by J. V. Stalin—34 presidents, 34 members of the Organizing Committee, 28 foreign and 253 Soviet delegates, and additional official details are given. Many good reproductions of pictures adorn the volumes, amongst them portraits of Mendeléeff's father and mother, which are probably little known outside Russia.

The efforts made in 1934 by the Russian authorities and scientific workers to celebrate one of their greatest compatriots are now put on record in an appropriate manner by these two fine volumes.

F. A. P.

The Plant Diseases of Great Britain:

a Bibliography. Compiled and annotated by Dr. G. C. Ainsworth. Pp. xii + 273. (London: Chapman and Hall, Ltd., 1937.) 15*s*. net.

THIS book, to which Dr. E. J. Butler has contributed a foreword, is a successful attempt to provide the plant pathologist—at rather a high price—with the key references to the literature on the principal plant diseases of Great Britain. The 183 host plants are conveniently arranged in groups as in the Ministry of Agriculture's reports on the annual occurrence of plant diseases, from which most of the nine hundred diseases included were taken. Under each host there is a list of diseases that may affect the plant and, where possible, the common names applied to these diseases are those recommended by the Plant Pathology Committee of the British Mycological Society. The attempt to name viruses and virus diseases will be particularly welcomed by plant pathologists. A selected list of literature references, mainly English but with a sprinkling of foreign papers, is given for the majority of the diseases, and each reference is briefly annotated to indicate the contents of the paper. Where a paper is abstracted in the *Review of Applied Mycology* a reference to this is given. Two indexes are provided, one of authors and one of hosts and parasites.

The selection of the English literature has been extremely well made, but many quite uncommon or doubtfully parasitic diseases are included without comment. Indeed, the value of the book to economic workers, both in Great Britain and Overseas, would have been greatly increased if the author had attempted to assess the relative importance of the diseases, for the number of articles published about a particular disease is apt to give a very misleading impression of its economic significance. The references have evidently been carefully checked, but elsewhere misprints are frequent. W. C. M.

Commercial A.C. Measurements

By G. W. Stubbings. Second edition, revised. Pp. xvi + 348. (London: Chapman and Hall, Ltd., 1937.) 15*s*. net.

THIS book has been written primarily for testing engineers. For students reading for engineering examinations it will not be so useful, as there are no examples given to illustrate the application of the theory given to practical work. The author has reduced the mathematical theory to a minimum, and so does not discuss the cases where three vectors cannot be represented by three lines lying in one plane, or stated the full conditions that must be satisfied in order that the power factor of a circuit may be unity.

The author's descriptions are easy to follow and he is thoroughly familiar with the methods used in the testing departments of power stations. Apparently it is customary to express the errors of watt-hour meters as a percentage of the true registration, the number being + (positive) if the meter is fast and − (negative) if it is slow. The average consumer would probably understand the meter card more easily if fast were written for + and slow for −. It is quite unnecessary to burden the memory in this case.

Handbook of Engineering Fundamentals

Prepared by a Staff of Specialists under the Editorship of Ovid W. Eshbach. (Wiley Engineering Handbook Series, Vol. 1.) Pp. xii + 1036 + 50. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

THIS book is divided into thirteen sections beginning with mathematical and physical tables and proceeding through such other subjects as mathematics, mechanics, flow of fluids, thermodynamics, electricity and magnetism, radiation, light, acoustics and meteorology, chemistry, metallic and non-metallic materials, to a final section on contracts, and certainly deals with the fundamental subjects required by the engineer.

The forty authors responsible for this work have been selected in equal numbers from the academic and industrial fields, so that, whilst the theoretical aspects of the various subjects are not overlooked, the practical applications of the theories receive due attention.

Intended as an introduction to the two volumes comprising Kent's "Engineering Handbook", and the two volumes constituting the "Handbook for Electrical Engineers", all of which are of uniform size, it possesses much useful information, but the English reader must always remember that it treats of American practice. Although containing nearly eleven hundred pages, the book is of convenient size, clearly printed, well illustrated, and firmly bound in flexible covers; it should prove a useful addition to the library of the engineer.

The Metabolism of Living Tissues

By Dr. Eric Holmes. Pp. xi + 235. (Cambridge: At the University Press, 1937.) 7*s*. 6*d*. net.

SIR F. GOWLAND HOPKINS has written a foreword in which he calls this a highly original book. Its chief claim to originality probably lies in its popular style, which strays from the narrow vocabulary generally used in scientific works in a way that is likely to shock the purists. The book is meant to be read straight through by students of biochemistry at the beginning of their course, and is likely to appeal to such readers. Advantage has been taken of the fact that the contemplation of structural formulæ brings æsthetic satisfaction to many who do not really understand them. Such contemplation is encouraged by an invitation to compare the formula of the lactoflavin in vitamin B_2 with the prosthetic group of Warburg's yellow pigment. The two substances are identical, but it takes the beginner some time to discover this fact because the two versions of the formula are written differently.

After some general remarks about enzymes, oxidations and redox potentials, the metabolism of the liver, kidney, muscles and nervous system are discussed in separate chapters, with particular emphasis on carbohydrate metabolism. This is probably the best part of the book. Hormones and vitamins are mentioned in later chapters, and their formulæ given. The book is intended as an introduction. There is a danger that it will come to be regarded by students as a complete account of all that they need to know.

Chemistry of Indian Opium

By Dr. H. B. Dunnicliff, Chemical Adviser, Central Board of Revenue, Government of India

OPIUM is the spontaneously coagulated latex which exudes when the partly ripened capsules of *Papaver somniferum* L. are lanced on the living plant. On exposure to air, the white, pale-yellow or pink latex turns darkish brown and, increasing progressively in viscosity, finally becomes quite hard. The product, called 'raw opium', is brown and soft inside, and has a characteristic smell and bitter taste. As marketed, raw opium contains about 15 per cent of water, some sugar, salts, albuminous substances and colouring matter. Its most valuable constituents are varying amounts of the meconates of some twenty-five alkaloids, the chief of which is morphine. At the time of collection, the content of morphine in Indian opium is not less than 8 per cent, though 16–20 per cent has been recorded when only latex from first lancings were taken. Narcotine (5–7 per cent); codeine (1–2 per cent), papaverine (0·4–1 per cent), thebaine (0·2–0·5 per cent) and narceine (0·5–1 per cent) are also present.

Opium waste products and contraband opium are used for the manufacture of morphine and other opium alkaloids. Excise opium is used in medicine, but in India much is chewed in harmless quantities.

The Hague Convention and the Dangerous Drugs Convention of 1925 have given international definitions to the two other varieties of the commercial drug, "prepared opium" and "medicinal opium". For the latter, selected chaláns of raw opium containing 9·5–10·5 per cent of morphine are employed.

In 1926, the Government of India discontinued the auctioning of "provision" opium for export and undertook the sales direct, the policy for many years having been to deal only with Governments. Also the supplies to Far Eastern countries for purposes other than medical and scientific were reduced by 10 per cent annually so as to extinguish exports by December 1935. This decision has involved great financial sacrifice to India, the sales in 1926–27 having yielded 3·36 crores of rupees (a crore is ten million rupees, approximately £750,000), while, in 1936–37, no revenue was collected under this head.

Experts have been frequently employed to report on the preparation of standard opium for sale and, for nearly thirty years, the technical side of the factory has been under the control of a chemist. W. A. Davis[1], indigo research chemist to the Government of India, deputed to report on the manufacture of medical opium and opium alkaloids at Ghazipur, recommended the installation of modern factory and laboratory research equipment, and showed how the Ghazipur Factory could produce a standard opium in sufficient quantity completely to replace that from Turkey and Persia in the English and American markets. Indian medical opium, the manufacture of which at Ghazipur was first undertaken during the Great War to replace the supplies no longer available from Turkey owing to international hostilities, is a better standardized product than that from Turkey. Indian opium also contains more codeine (2–4 per cent) than the Turkish variety (less than 1 per cent).

H. E. Annett and his co-workers[2] have made valuable contributions to the chemistry of opium and its alkaloids. With Bose, he showed that the observed increase in the percentage ash of the latex of the opium poppy at each successive lancing up to the fourth is accompanied by a decrease in the total alkaloid content of the latex. The principal loss was in morphine, while the codeine–morphine ratio rapidly increased at successive lancings. They failed to establish any relationship between the nature of the soil and the morphine content of the opium grown on it, though there was clearly some local factor influencing the power of a plant to produce the alkaloids. Different races of poppy possibly produced opium of varying morphine content and special strains could be produced by selective manuring. Organic manures caused an increased yield of opium of higher morphine content. Similar results with superphosphate linked the beneficial effect with the phosphoric acid in the manure.

Indian opium was, and still is, inferior to Turkish opium in morphine content. This can be ascribed to such factors as faulty methods of harvesting, defective lancing and collecting, the deterioration of opium on storage and environmental conditions in India, which are unfavourable when compared with those of Turkey, where the latex is collected in a moist atmosphere with a falling temperature, while the reverse conditions, favourable to bacterial deterioration, prevail in India.

In cloudy or moist weather a brown, watery substance called 'pasewa' exudes from opium. It used to be employed as 'lewa', a mixture of pasewa and inferior opium, in pasting poppy petals as a protective layer round the balls of provision opium. Opium mixed with excess of pasewa is termed 'pasewa amez', but little is known of the genesis, chemistry or properties of pasewa and its peculiar sensitiveness to climatic conditions.

Considerable controversy arose over the assays of opium and its alkaloids submitted to the English market for sale. These differences between results of the English chemists and the Indian factory analysis were traced to different methods being employed for the evaluation of the opium and the purity of morphine hydrochloride, and the interpretation of the results.

In 1915, the chemical work of the Ghazipur Laboratory was done by the assistant opium examiner, W. W. Todrick. His staff was augmented in 1915 by a chemical assistant, J. N. Rakshit (Rai Sahib, 1926), who eventually succeeded Todrick. Later he was designated factory chemist, but in 1929 he was appointed to the newly created post of opium chemist to the Government of India.

In 1917, Rakshit[3] showed that opium yields about 2·5 per cent ammonia, and, a year later, isolated a complex substance he called "opium wax"[4]. Its composition varies widely from different sources, giving saponification values, 113–126, acid values, 41–45, and iodine values 130–170. The presence of hydrocarbons is also indicated, and from two other components; J. N. Ray (Lahore, unpublished work) has separated acids melting at 76° and 178° respectively, the latter being most probably a resin acid. Hence Ray suggests that opium wax is probably a resin, since destructive distillation yields an oily product resembling the higher terpenes.

Rakshit[5] isolated porphyroxine from opium and reported it to be a crystalline compound with a sharp melting point different from the mixtures examined by Merck (1837), Dey (1883) and Hesse (1894). Rakshit's proposed structure for this compound has been the subject of criticism in view of the development of the chemistry of morphine.

The determination of the morphine content is a most important but controversial question, leading to modifications of standard procedure from time to time.

The Indian Opium Factory sales of medical opium of standard strength for supply to medical men and hospitals have increased from 511 lb. in 1922 to 1,800 lb. of medical opium powder and medical opium cake of B.P. 1932 strength in 1936. During the year ending September 30, 1936, 1578 lb. of crude morphine, 130 lb. of morphine hydrochloride, 14 lb. of morphine sulphate and 284 lb. of codeine were sold from the Factory. Cotarnine prepared by the oxidation of narcotine has been made to supply special orders.

Literature on the problem of the loss of morphine from opium on storage has been summarized in an article by Dunnicliff, Ray and Singh[6]. Their investigations show that the morphine content of Indian opium does not fall if it is stored under anærobic conditions in a moist condition but that, if dried at 60° and stored in contact with air, it suffers a rapid loss of the alkaloid. When dried at 98°–100° and stored out of contact with air, the fall in morphine content is small. Simple trituration of opium with lime shows that there are ammonium salts present, but it is claimed that their formation is not due to the degradation of morphine as hitherto believed.

The consumption of excise opium in India has decreased steadily for the last six or seven years, the issues from the Ghazipur Factory having fallen from 12,767 maunds in 1919 to 5,665 maunds in 1936. This decline is to be attributed partly to the economic depression of recent years and partly to the steady increase in the duty on opium. To a large extent, opium-eating in India is quasi-medical, being used by the poor as a very common and highly valued household remedy. Its physiological importance depends not only on its morphine content but also on the presence of alkaloids like codeine, papaverine, etc., which assist in the relief of many ailments.

The conclusion that opium may have an antimalarial action was based on the low incidence of malaria in certain districts where opium was regularly consumed. Gordon affirmed the prophylactic value of narcotine against malaria, but Chopra and Knowles[7] have shown that it has neither curative nor prophylactic value in malaria, even in large doses.

Ahluwalia, Kochhar and Ray[8] oxidized narcotine to cotarnine in good yield and prepared a number of derivatives of cotarnine. One of these formed from resorcinol was found, like quinine, to be an antipyretic and toxic to Paramecia. Its acetyl derivative may possibly find some application in gynæcology, while cotarnine phthalate is a stypic.

The opium habit, the physiological results of smoking opium, the effect of opium and morphine on the human system and morphine addiction in India have all received the attention of scientific workers and official commissions[9], from the reports of which valuable information on these important sociological problems may be found.

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[1] Report on the Opium Factory, Ghazipur, by W. A. Davis (Government Press, U.P., India, 1918.)

[2] *Bull. Agric. Research Inst. Pusa*, **116** (1921); *Mem. Dep. Agric. India*, **6**, 1, 2 (1921); **8**, 2, 3, 4 (1925); *Agric. J. Ind.*, **6** (1922).

[3] *Pharm. J.*, **98**, 255 (1917).

[4] *Analyst*, **43**, 321 (1918).

[5] *J. Chem. Soc.*, 455 (1919); *Ber.*, 2473 (1926).

[6] *Proc. Nat. Inst. Sci. India*, **1**, 107 (1935).

[7] *Indian J. Med. Res.*, **18**, 5 (1930).

[8] *J. Indian Chem. Soc.*, **9**, 215 (1932).

[9] "A.B.C. of Narcotic Drugs", by O. Anselmino. (League of Nations. Permanent Central Opium Board. Geneva, 1931.) Report of the Royal Commission on Opium, 1895. Report of the International Opium Commission, Shanghai 1909 (*North China and Daily New Herald Ltd.*, Shanghai 1909). "Indian Opium", *Bull. Imp. Inst.*, 1915. "The Truth about Opium", by W. Brereton (1882).

Recent Caterpillar Plagues in Great Britain

THE epidemic occurrence of the caterpillars of the Antler moth (*Charæas graminis* L.) in the north of England and Scotland, and of the Willow 'Small Ermine' moth (*Hyponomeuta rorella* Hb.) in Suffolk, have been the subject of considerable comment, not to say confusion, in the daily Press, and since the two outbreaks are of a very different type a brief account of their essential features may be of interest.

The species first mentioned is widely distributed throughout Great Britain, haunting chiefly moor or downland, and the poorer types of pasture, where the larvæ feed on *Festuca ovina*, *Nardus stricta*, and grasses of a similar type. In lowland regions, the Antler moth appears never to increase to such numbers as to do appreciable harm ; but in hill districts from South Wales and Derbyshire northwards, moorland pastures, usually at a considerable elevation, may suffer very severely, the grasses being largely destroyed and only a brown 'mat' of dead grass left. The caterpillars then occur in such numbers as to be driven by starvation to migrate in vast hordes, blocking streams and water courses, or collecting in heaps at the base of walls or other obstacles. This migratory stage, if that term be applicable, is reached when the caterpillars have nearly completed their feeding, and although a certain proportion crawl downhill towards the lowland meadows, the latter never seem to be damaged. Antler moth outbreaks occur relatively infrequently, as the following records show, although there may have been others on a smaller scale of which records have been overlooked, notably between 1827 and 1881 :

1827	Skiddaw[1].
1881	Lancashire (Clitheroe)[2], Derbyshire[6].
1884	Glamorgan[3].
1885	Selkirk[4].
1894–95	Selkirk and south-west Scotland[5].
1910	Glamorgan[6].
1917	Derbyshire[6].
1935	Wales (Brecon).
1936	Brecon Beacons and Cader Idris, north-west England.
1937	Cader Idris (slight compared with 1936), north-west England, Scotland.

It is evident, therefore, that outbreaks seldom occur for more than two years in succession in the same area, and often they are confined to single years with long intervals in between. The factors that lead to these enormous increases in numbers are at present unknown. The outbreak in Derbyshire in 1917 was investigated by Imms and Cole[6], and they suggested that these factors were possibly climatic, and the fact that the hills were snow-covered in 1916–17 might have given the species greater protection during that winter. Since, however, the insect spends this season in the egg stage (a fact not then known) this explanation is not very likely to be correct. An alternative suggestion discussed by Imms and Cole was that the failure to burn hill pastures during the Great War had favoured the outbreak, but again this explanation can scarcely apply generally, and it is more probable that the causes of an outbreak are complex and due to the interaction of both climatic factors and the varying incidence of the natural enemies of the moth.

The matter clearly needs investigation; but owing to the considerable period of years that may elapse between outbreaks and the necessity for intensive field and laboratory work every year, regardless of outbreaks, the problem would seem to be more appropriate to a university department with a succession of students than to a research worker in economic entomology, who would not be able to give annually so large an amount of time required to a problem that, taken over an average of years, is not of great economic importance. So far as direct control measures are concerned, nothing of a practical nature is yet known, since the value per acre of moorland grazing is so small that it will not carry any appreciable expenditure on caterpillar control.

The Antler moth outbreaks are thus typical of a resident species that normally occurs in small numbers, but is occasionally released from the factors that exercise a natural control.

The outbreak of the other species attracting attention, the Willow Small Ermine moth (*Hyponomeuta rorella*) is of a different character. This moth, until 1936, was regarded as a very rare species in Great Britain, having been noted only in Sussex and Dorset, and even in these counties there seems to be no record of any permanent colony. In 1936, however, the marshland willow trees in the neighbourhood of Beccles in Suffolk were found to be heavily infested by the larvæ, and specimens were also received from Barnby, farther down the Waveney valley, while a single specimen was taken at Rockland Broad in the valley of the Yare in Norfolk, some twelve miles from Beccles[7].

According to Goldsmith, who first recorded the Suffolk outbreak[8], larvæ had been noted at Beccles some five years before his attention was directed to them. It is thus possible that there may have been a small nuclear colony of the species in Suffolk for many years. This, however, is not very likely, since the Beccles neighbourhood has been fairly well worked in respect of the Lepidoptera, and the 'nests' of the larvæ are so conspicuous that they could scarcely be overlooked. On the whole, it is more probable that the species is a recent arrival in Suffolk, having either flown or been carried by boat from the Continent.

If this suggestion is correct, the conditions favouring an epidemic increase might easily have been fulfilled, since the moth would arrive without its natural parasites, and feeding upon willows in a marshland district, where other members of the genus are not abundant, it would gain some years' start before being found by any indigenous parasites. In 1936, the rate of parasitism was certainly very low. Mr. Stringer, of the British Museum (Natural History), reared from Beccles larvæ the species *Herpestomus brunneicornis* Grav., an ichneumonid that frequently attacks the allied *Hyponomeuta padella*; but the writer obtained no parasites whatever either from Beccles or from Barnby material.

Provisionally, then, *H. rorella* may be regarded as an invader (in contradistinction to the indigenous *C. graminis*), and although it is very unsafe to prophesy, it is at least possible that it will be increasingly parasitized, and even perhaps brought completely under control as soon as it is discovered by the parasites of our native species of *Hyponomeuta*—a process that might be hastened artificially if it were considered worth while.

As to the economic importance of the insect, it is not possible as yet to give any definite opinion. If cricket bat willow or basket willow were attacked, the species might prove a serious menace, notably to the former, since the spraying of large trees is seldom commercially worth while. Fortunately, there is some hope that neither will be affected. In Suffolk, the trees that are suffering appear to be *Salix alba* (although the writer claims no expert knowledge in this respect). However this may be, larvæ of the *rorella* brought from Beccles, and also others reared in captivity from the egg, have been given the foliage of the true cricket bat willow, but neither in 1936 nor 1937 were they able to survive on it. Similarly, they refused to feed on *Salix caprea* or other 'sallows', or on one of the basket willows that was given them. The experiments were not sufficiently extensive to justify any final conclusion in respect of the cricket bat willow, but they are at least suggestive and show that *H. rorella* is very specific in its tastes.

A note on the outbreak in 1936 was published in the *Entomologist*[7], to which readers may be referred for a description of the larvæ and the damage they do.

J. C. F. F.

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[1] Curtis, "Farm Insects", 507 (1883).

[2] Ormerod, "Report on Injurious Insects", 21 (1881).

[3] *ibid.*, 16 (1884).

[4] *ibid.*, 12 (1885).

[5] *ibid.*, 12, (1894) ; 18 (1895).

[6] Imms and Cole, *J. Board Agric.*, **24**, 516 (1917-18).

[7] Fryer, *Entomologist*, **69**, 269 (1936).

[8] Goldsmith, *Entomologist*, **69**, 217 (1936).

Nottingham Meeting of the British Association

As has already been announced, the annual meeting of the British Association will this year be held in Nottingham on September 1–8, under the presidency of Sir Edward Poulton. Twice previously the Association has held its annual meeting in Nottingham. In 1866, before the foundation of University College, Nottingham, Mr. Justice Grove, Q.C., the inventor of the Grove cell, was president. It was at this meeting that Wheatstone was president of Section A (Mathematics and Physics), before which Joule read a short paper on the heating effect of an electric current in a wire, and one wonders if this paper was an abridged version of that which Wheatstone is reputed to have rejected in his capacity as a referee for Royal Society publications. At the same meeting, Sir William Huggins gave an evening discourse on the applications of spectroscopy to the problems of stellar constitution. Among the more distinguished members present in 1866 were Frank Buckland, T. H. Huxley, A. R. Wallace, W. Crookes and H. E. Roscoe, while Dean Farrar contributed to discussions on the teaching of science in public schools, and C. F. Varley reported on the Atlantic cable successfully completed a month before the meeting. Among the visits paid to local industrial undertakings was one to Messrs. Taylor's bell foundry in Loughborough, and it is pleasant to think that members will again have an opportunity of visiting the works this September.

In 1881 the University College, Nottingham, buildings in Shakespeare Street, near the centre of the city, were opened, and these were the headquarters of the Association at its annual meeting in 1893. Dr. J. S. Burdon Sanderson was president, and Sir Richard Glazebrook was president of Section A, which was remarkably active, and at which a committee presented a report on the foundation of a National Physical Laboratory.

This year the Association will hold all its sectional meetings in the University College buildings in University Park, provided by the munificence of the late Lord Trent and opened by H.M. King George V in July 1928. Here the members will be able to enjoy extremely pleasant surroundings, and, if they wish, refresh themselves in an open-air swimming pool.

Nottingham is the centre of a large number of industries; its connexion with textiles is well known, and there are large chemical, mining, tobacco, bicycle and general engineering undertakings in the city and immediate vicinity. Since the last meeting here, interest in lace manufacture has declined, or, rather, been replaced by activity in hosiery manufacture. Visits to representative works have been arranged, including an excursion to a coal mine, and the Geography and Geology Sections of the Association are combining in a discussion on the potential resources of the area. Members visiting Nottingham for the first time will find much to interest them in the many excursions which have been arranged to the surrounding countryside.

A meeting in which local members should be considerably interested is an evening discussion arranged between six sections on the planning of the land of Britain. A joint meeting of the Education and Geology Sections to discuss the teaching of geology in schools is also likely to be keenly followed, and Mr. H. G. Wells's presidential address to the Education Section will naturally be of considerable interest. In addition to the evening discourses, one on "Illusions of Colour" to be given by Prof. H. Hartridge and another on "Grass and the National Food Supply" by Dr. R. E. Slade, a series of popular lectures for non-members has been arranged in the neighbouring towns. Dr. Alexander Wood will address a company of Nottingham children on "Noise", Sir Gilbert Walker will talk to a Derby audience on "The Science of Sports", Mr. R. Kay Gresswell will talk on "Rivers" at Lincoln, Dr. J. E. Constable on "Everyday Application of Physics" at Long Eaton, Prof. J. Walton on "Coal and its Origin" at Mansfield and Mr. T. M. Herbert on "Transport of Food" at Newark.

The Lord Mayor and members of the City Council will hold a civic reception at Nottingham Castle on Thursday evening, September 2, and the College Council will give a garden party on September 7. On these occasions members should find ample opportunity of meeting many of the local scientific workers and citizens who are interested in the aims and objects of the Association and who are working to make the Nottingham meeting a successful one in every way.

Obituary Notices

Prof. Thomas Mather, F.R.S.

THOMAS MATHER was a man who worked his way up to an important and honourable position from a starting condition devoid of all advantages due to financial or personal support. His early training was that of a carpenter. By strenuous evening study he won a Whitworth Scholarship at a time when these scholarships were few in number and of greater money value than is nowadays the case. With the aid of this scholarship, he supported himself at college throughout a fairly complete course of full-time study. His early education was not such as to make it possible for him to meet all the academic conditions at that time needed in order to qualify for a science degree. He could not get a degree but he could, and did, work hard at physical, mathematical, and engineering subjects, so as to leave college with a thorough grip of them. He next became an assistant to Prof. W. E. Ayrton at the start of the technical teaching work financed by the City and Guilds of London Institute. He followed Prof. Ayrton from the college at Finsbury to the one at South Kensington which is now part of the Imperial College. On the death of Prof. Ayrton he succeeded him as professor of electrical engineering. When he died on June 23, he had lived more than eighty-one years, and during half that period he was a fellow of the Royal Society.

Mather joined Prof. Ayrton's staff at Finsbury in 1881 before the College was actually built, and while the City-Guilds classes were carried on in a boys' school, part of the playground of which was afterwards used as the site for the College. The classes at the school and later on at the College were held mainly in the evening, and were thronged with adult students all engaged in the new industry of electrical engineering. At that time, trained men were not to be found, and electrical engineering departments did not exist. There was a new and sudden demand for large laboratory classes to train men in the use of apparatus utilizing electrical currents of a magnitude previously unknown. The development of suitable training courses with corresponding testing appliances called for much ability and initiative. Prof. Ayrton at first directed this work, but later on was content to leave it almost entirely in the capable hands of his assistant. The work grew in volume and altered in character with the change from the Finsbury to the South Kensington College, with the establishment of three-year College day-courses, and with the rapid development of electrical engineering. As years passed, the laboratories had to be enlarged and their equipment increased, and many new members of the staff had to be engaged. Mather throughout remained in control. The main work of Mather's life consisted in the development of these laboratories and in the constant assistance given by him to those who worked in them whether as ordinary course students or as exceptional ones, like Duddell, carrying out important original work.

For many years, Mather could not lecture since his speaking suffered from an impediment so serious that he often had to resort to paper to explain what he wished to say. He was quite unable to take part in the discussions at the Institution of Electrical Engineers, or at the Physical Society. Had he been able to do so, he would have been more adequately appreciated outside the College than was the case. His struggles to overcome his disability were at times pathetic, but during and after 1914, to the astonishment and delight of everyone who knew him, he was able to give lectures. These were highly esteemed by his students.

From the pure science point of view, Mather's most valuable work was an investigation concerning details in the improvement of the standard cell and involving an accurate determination of its electromotive force. This work formed the subject of papers to the Royal Society, and was probably the main factor determining his election to the fellowship of the Society.

Technical men will remember Mather best for a number of papers written, mostly in conjunction with Prof. Ayrton, dealing with improvements in the construction of electrical instruments of all kinds. An instance is a set of papers on galvanometers and accessories such as the well-known Ayrton-Mather shunt. Another consists of his work on electrostatic voltmeters, which involved most skilful and careful design. These instruments were widely used in practice, since at the time they were first produced they were much wanted and were the best available instruments of their kind. The precision wattmeter of Mather and Duddell is another instance of the excellence and care in detail of Mather's work. First-rate instruments and appliances suitable for college or industrial testing are now commonplace articles of commerce, but such a result could only be reached after much previous work had been done in laboratories established for technical teaching. Mather was one of the earliest and ablest pioneers in this work.

In nature, Prof. Mather was most modest and retiring. He was always kindly and willing to help in either simple or advanced work, and never wished to have such help acknowledged in public. He was personally much liked and was held in honour by all who knew him. It would be hard to value too highly the influence of a man who spent so many years guiding the laboratory training of ordinary students and in helping in the research work of others, many of whom have become highly distinguished men.

Prof. Albert Griffiths

PROF. ALBERT GRIFFITHS was born at Chester on October 8, 1867, and after the removal of his family to Manchester was educated at the Manchester Central School, the Royal College of Science, London, and in 1887 won the Dalton entrance scholarship to the Owens College, Manchester, then one of the constituent colleges of the Victoria University. He was one of the first students to read for the honours degree in physics of the University, and at the end of his first year was awarded the Heginbottom Scholarship. He obtained the degree of B.Sc. with first-class honours in 1890, and went to Germany to continue his studies at Freiburg.

In 1893 Griffiths was elected to a Bishop Berkley fellowship at the Owens College, and commenced a series of electrical researches, an account of which he published in the *Philosophical Magazine*, vol. 39, in 1895. He was appointed demonstrator in physics on the termination of his fellowship in 1895 and lecturer in physics at University College, Sheffield, in 1898. Griffiths obtained his D.Sc. degree in 1899 and in the following year, after acting as head of one of the students' hostels at Sheffield, was appointed head of the physics department of Birkbeck College, London, and ultimately professor of physics. He held this position until his retirement in 1933, and founded a school of research which concerned itself mainly with problems of diffusion of salts in solutions and improvements in the methods of determining coefficients of diffusion. Heart trouble set in during the summer of 1935 and became rapidly worse early in 1937; he died on May 24. He leaves a widow and one son.

WE regret to announce the following deaths:

Prof. H. E. Armstrong, F.R.S., emeritus professor of chemistry in the Imperial College of Science and Technology, City and Guilds (Engineering) College, on July 13, aged eighty-nine years.

Dr. A. A. Bialinycki-Birula, formerly director of the Zoological Museum of the Russian Academy of Sciences, known for his zoological work in the Arctic and for systematic work on scorpions and Solifugidæ, aged seventy-three years.

The Right Hon. Lord Ernle, M.V.O., president of the Board of Agriculture and Fisheries in 1916–19, who received the Gold Medal for 1935 of the Royal Agricultural Society "for distinguished service to the farming industry", on July 1, aged eighty-five years.

Prof. A. W. Gibb, emeritus professor of geology in the University of Aberdeen, on July 12, aged seventy-three years.

News and Views

H.M. the Queen and the University of Edinburgh

At a special graduation ceremonial on July 8, the Senatus Academicus of the University of Edinburgh conferred on Her Majesty the Queen the honorary degree of doctor of laws. The degree was conferred by the vice-chancellor, Sir Thomas Holland, who expressed to Her Majesty the thanks of the University. In her reply, Her Majesty said, "I thank you, Mr. Vice-Chancellor, for the very kind words with which you have admitted me to-day to your Roll of Honour, and I assure you that I deeply appreciate the distinction which the University of Edinburgh has conferred upon me. As a Scotswoman I know the high value which my fellow-countrymen set upon education, and the important part which a university such as this plays in the civic and national life. It is very gratifying, therefore, to me to feel that as a member of this great University I am connected with so important a centre of Scottish life and thought. It is my earnest hope that this ancient foundation will long continue to prosper, and I can assure you that its interest will always lie very close to my heart." Among those present were the Right Hon. Ramsay MacDonald, and Prof. J. Graham Kerr, two of the members of Parliament for the Scottish Universities.

Sir David Prain, C.M.G., C.I.E., F.R.S.

Scientific workers in general and botanists in particular will join in congratulations and good wishes to Sir David Prain on the occasion of his eightieth birthday, which he celebrated on July 11. Sir David Prain's career as a botanist began with his appointment as curator to the Calcutta Herbarium some fifty years ago. After twenty-one years' distinguished service to the cause of botany, both pure and applied, in India, Sir David was appointed to the directorship of the Royal Botanic Gardens, Kew, a post which he occupied no less successfully for seventeen years. On the present occasion, however, we think not merely of his many services to the welfare of science but also of his personality that has gained for him both the esteem and the affection of his colleagues. It was this personality and his wise council that rendered Sir David so eminently successful during his presidency of the Linnean Society and of the Imperial Botanical Congress, and caused him to be in so great demand as a chairman. That his kindly charm and valued advice may be long spared to us will be the wish of all his colleagues.

Prof. R. M. Gordon

Prof. R. M. Gordon, professor of tropical diseases of Africa in the University of Liverpool, has been awarded the Chalmers Medal of the Royal Society of Tropical Medicine and Hygiene, which is given annually for research of outstanding merit in tropical medicine or hygiene. It is one of the conditions of the award that the recipient should be less than forty-five years of age. Prof. Gordon's first experience of medical research in the tropics was in Brazil, where he worked for several years on the Amazon, in the laboratory at Manaos directed by the late Dr. Wolferstan Thomas. After this, he was transferred to the staff of the Sir Alfred Jones research laboratory in Sierra Leone, West Africa, where he has since remained. In 1929 he became director of that laboratory, and in 1930 the University of Liverpool elected him to the chair of tropical diseases of Africa. Prof. Gordon has not been in the fortunate position of being able to select a subject and settle down for a long period of years of quiet research, in a specially equipped laboratory, aided by well-trained laboratory assistants, and free from administrative and financial worries. On the contrary, he has at all times had to carry out many routine duties and has had distracting difficulties and responsibilities with which to contend. When it is remembered also that the whole of his research has been conducted in the trying climate of the worst parts of the tropics, it is a great testimony to his initiative and perseverance that he has succeeded in maintaining a standard of work which compares so well with that of colleagues working in much more favourable circumstances.

Dr. Gordon's first publication was from South America, in the year 1921, and dealt with an experimental investigation into the feeding habits of *Stegomyia calopus*. In 1922 he published a record of the ancylostomes collected at sixty-seven autopsies; it was this early interest in the subject which led soon after to the publication from Sierra Leone in 1925 of a very important paper "On the effect of *Ancylostome*, *Ascaris* and *Trichuris* infection on the health of the West African natives". In bilharziasis, which constitutes a serious menace in large areas of Sierra Leone, as in many other parts of the tropics and sub-tropics, he has made notable advances by the discovery of a focus of *Bilharzia mansoni* infection, and by a very complete experimental study of the mode of transmission, and of the much debated question of the anatomy of the cercariæ. His contribution to the study of malaria in many of its aspects, especially as it affects pregnant women in endemic areas, and to the subject of metazoan immunity, assume the greater value the more research on these subjects advances. His latest paper records the discovery of typhus fever in West Africa, a discovery which is clearly destined to have far-reaching results. His investigations into the distribution and bionomics of anopheline mosquitoes in the Freetown area, carried on steadily now for many years, have yielded and will yield valuable data applicable to similar regions throughout the tropics.

General Hertzog and the South African Protectorates

GENERAL HERTZOG, Prime Minister of the Union of South Africa, on his return to South Africa from attending the recent Imperial Conference in London, once more raised publicly the question of the transfer of the administration of the native Protectorates in South Africa from the Imperial Government to the Government of the Union. According to a message, which appeared in *The Times* of July 7, he alleged that the British Government has failed to carry out pledges of early transfer, which were not only conveyed to him personally by the responsible minister on several occasions, but also were embodied in the agreement which formed the substance of the *aide-mémoire* framed and made public in 1935. He went on to assert that instructions issued by the British Government to its administrative officials in the Protectorates have failed to carry out an undertaking to direct those officials to bring their influence to bear on the natives in such a manner as to induce in them an attitude favourable to the transfer to the Union.

MR. MALCOLM MACDONALD, Secretary of State for Dominion Affairs, lost no time in his reply to General Hertzog's criticisms. In a statement to the House of Commons on July 9, he made it clear that not only was there no agreement that transfer would take place within a specified time, but also that when General Hertzog had urged upon him in a personal interview that transfer should begin in the near future, he had pointed out in his reply that the situation described in the *aide-mémoire* had not greatly altered. Further, he went on to indicate that General Hertzog has been kept fully advised of developments in the matter of the Protectorates, not least of the terms of the instructions issued to officials, in which he has fully concurred. Not only did Mr. MacDonald's action meet with the full approval of the House, but also his further reiteration of the pledge that no action in the matter of transfer would be taken without previous consultation of the inhabitants of the Protectorates received its full endorsement.

Grassland Management in Great Britain

IN his presidential address delivered on July 14 to the Fourth International Grassland Congress held at Aberystwyth, Prof. R. G. Stapledon gave an interesting summary of his views concerning the approach to grassland problems in general and also in relation to the special circumstances of grassland management in Great Britain. The most hopeful line of attack on the general problem, Prof. Stapledon believes, is by employment of the regional survey method, as developed by the Aberystwyth workers in their treatment of the grasslands of Wales. The procedure is to map, classify and plan on the basis of natural regions; adapting to each the correct type of implements, fertilizers and especially the correct strains of seeds. The breeding of herbage plants should be carried out in the area for which they are intended, and interchange of genes between different countries is more likely to be fruitful than interchange of seeds. Of the many factors concerned in the making of useful grassland, the animal is by far the most important; next comes the leguminous plant. Improvement in many instances consists in setting up such soil conditions that a suitable legume will grow, and then adopting a system of management to favour the legume as well as the grazing animal. Then follows the possibility of growing superior herbage plants that had never succeeded before in that area.

TURNING now to some of the special problems of grassland farming in Great Britain, Prof. Stapledon made a strong case for the use of the plough on grassland wherever possible. The method should be to graze hard before breaking up with the view of laying up a store of organic manure or 'stock nitrogen' in the soil. After ploughing a dressing of lime is given, and the accumulated fertility is then in shape to be cashed in the form of some arable crop or immediately put back into still better pasture. Another point of the greatest importance is the production of out-of-season keep. Much has been done lately to conserve summer grass in dried form for winter feeding, but some progress has been made in growing good quality fresh grass for use between December and March. It is a case of species and management. Choosing winter green strains of plants, the grass is heavily manured through the growing stock, further assisted by a little mineral nitrogen, and rested from the end of summer onwards. Working in this way, the Aberystwyth workers have secured on occasions as much as 1½ tons of dry matter per acre with 14–20 per cent of crude protein between Christmas and the end of March. Here again young leys offer more possibilities than permanent pasture.

Archæological Excavations at Tell Duweir, 1936–37

AN exhibition of antiquities from Tell Duweir, the ancient Lachish, in Palestine, opened at the Wellcome Research Institution, Euston Road, London, N.W.1, on July 12. These antiquities, with an extensive series of photographs of the site and of the work of excavation in progress, represent the results obtained by the Wellcome-Marston Archæological Research Expedition to the Near East in the season 1936–37. The excavations were again under the direction of Mr. J. L. Starkey. The operations of the season were directed mainly to the investigation of three areas—the north-east corner of the mound on ground rising from the valley to the level of the moat of the Hyksos period; the great rock-cut excavation of shaft discovered in 1935, now ascertained to measure eighty-five feet long by seventy feet broad, with a depth of ninety feet; and the area lying behind the south-west gate, with the rising ground to the east reaching up to the walls of the Jewish palace. In the last-named area, water-borne deposits on the ancient roadway as it descends sharply on approaching the threshold of the inner gate, which had been due to the blocking of the drainage by the fall of the gateway before assault and conflagration, afforded the first tangible archæological evidence differentiating the two Babylonian attacks of 597 B.C. and 588 B.C., hitherto not clearly to be distinguished. Tunnels cut in the contents of the great shaft—water-borne deposits, overlying the stones of the collapsed walls of the Jewish city—have as yet afforded no evidence of exits or means of access, nor can the purpose of the shaft yet be determined. Work on this rock-cut shaft, it can be seen, was still incomplete, when it was abandoned, possibly as a result of frontier troubles before the fall of the Jewish kingdom.

A NOTEWORTHY feature among the exhibits is the collection of scarabs, which with the character of the amulets found at Tell Duweir in Sixth and Seventh Century tomb-groups illustrate the persistent influence of Egyptian beliefs and ways of thought among the peoples of southern Palestine. In one of the numerous rock tombs of the north-east corner of the Tell nearly two hundred scarabs of the Eighteenth and Nineteenth Dynasties were found. A continuous series of scarabs with the Royal name now covers the whole period of Egyptian occupation, with the exception of a gap of some fifteen years under Akhenaten and Tutankhamen. One of the most interesting objects in the exhibition, however, is a copper dagger, found in the excavations of 1934, but recently cleaned by the Palestine Museum of Antiquities and on loan by the Palestine Government. It belongs to the Hykos period and is certainly not later than 1600 B.C. Its interest lies in the fact that it is now seen to bear on one side characters in a pictographic script, affording proof of the development of a script independently of both Egypt and Mesopotamia. With the evidence of these pictographs of the now famous inscribed ewers and of the no less remarkable Lachish letters of the pre-exilic period, of which a detailed study by Dr. Harry Torczyner is now in the press, it is now possible to piece together something of the history of the development of writing in Palestine. The exhibition will remain open until August 7, a cinematograph film of the work of the expedition being shown twice daily; and on July 16 at 5.30, and July 28 at 6 p.m. lectures on the new discoveries will be delivered by Mr. Starkey at the Wellcome Research Institution.

Gold Mining with the Aid of Aeroplanes

MESSRS FRASER AND CHALMERS, of Erith, Kent, have recently equipped a gold mine at Progresso in Peru, which is at a height of 12,800 feet above sea-level in an almost inaccessible district about ninety miles south-west of the city of Cuzco. A description of this mine and of some of the difficulties that had to be overcome in transporting the whole of the mine equipment, weighing 150 tons, and the buildings, weighing about 1,000 tons, to the site of the mine is given in the *G.E.C. Journal* (General Electric Co.) for May by W. Bullock. A railway line runs to within about seventy miles of the mine; the connexion between them is a mountain track, which can only be traversed by mules and llamas, and the journey takes fourteen days to complete. As the track over the mountains is often merely a narrow ledge on the side of a steep hill, it is impossible to carry by animals pieces of machinery or equipment more than 10 feet long. Sectionalizing the plant to this extent rendered this mode of transport impracticable. The engineers therefore chartered and equipped two aeroplanes, each capable of carrying a load of two tons. In this way it was found possible to transport reasonable loads by air. The actual time taken by air was about one hour and that taken by a llama was 14 days. The cost of the latter method, if it had been practicable, would have been one third the cost of transport by air. The ore, after being mined, is reduced in a 'breaker' and brought into the mill on a belt conveyor. It is crushed to pieces of about 2 in. cube size and distributed into a 450-ton crushed ore bin situated behind the stamp mill, which is provided with 24 stamps each having a falling weight of 2,100 lb.

Pollution of Sea and Shore by Oil

FOR several years, persistent complaints have been made about the damage caused to organisms upon the sea-shore and particularly to birds which frequent the surface by oil discharged from ships. The number of birds whose feathers become so coated with the discharge that they are unable to fly or to dive for food, and in consequence die a slow death from starvation, has been reported to be very great in some years and in some places. From preliminary investigations into the whole subject of oil pollution at sea, Prof. N. K. Adam has written a report, submitted to the Council of the Royal Society, and printed for private circulation, the general effect of which is to allay some of the fears aroused by the earlier records and surmises. In the seas about the British Isles, the principal sources of oil are wrecks, fuel oil accidentally discharged, usually from ballast tanks, and sludge from the cleaning of oil tanks on tankers or oil-burning ships. But the nuisance due to the oil appears to have diminished in recent years, owing partly to the regulations which now prohibit the discharge of oil or oily water near the coast, and partly to the increased use of separators on board ships. A reassuring statement is that fuel oil entirely loses its tendency to spread after a few weeks at ordinary temperatures on a water surface in contact with gravel. On the surface of the sea also it seems to disappear, for it is rare to see an oily film, and it has been found that no appreciable amount is present as an invisible film.

As regards damage caused by oil to marine plant and animal life, the evidence is inadequate and often contradictory. Prof. Adam's impression is that the moderate amount of pollution round our coasts appears to be doing little damage to life, other than birds, either between tide-marks or below low tide level; and that in other places, if there is very heavy and continuous oil pollution, life between tide-marks is seriously affected, but there is not much evidence of damage below low tide. The impression of the present writer, however, for what it is worth, is that in a limited area where pollution may be high, animals not exposed between tide-marks suffer and may be exterminated, and the supposition was that even if adult sessile forms may be able to withstand pollution, the delicate free-swimming ciliated larvæ, by which most sessile forms propagate, succumbed, and multiplication accordingly ceased. But that and several other matters referred to in the report await the test of experiment.

Economic Value of an Experiment in Transplanting

FOR some seventy years before 1917, the State of Pennsylvania possessed no beavers, and in that year two, imported from Wisconsin, were set free. Between 1917 and 1924, 94 beavers were imported and liberated at a cost of about 50 dollars each. So rapidly did the creatures multiply that it soon became necessary to transfer some to other parts of the State. A survey by the Board of Game Commissioners gives an idea of what the increase meant: in 1931 there were 899 beaver dams with an estimated population of 4,377; in 1934, the population had risen to 15,000. During the trapping season of 1934 the number of beavers taken was 6,455, and the pelts brought the trappers a sum total of 22,610 dollars. Wherever beavers are doing damage, as in farming communities or in irrigation areas, the policy of the U.S. Bureau of Biological Survey has been to encourage and aid in the transference of the animals to carefully selected sites where their dam building may aid in the cause of conservation. To further this policy, the Bureau has published a *Farmers Bulletin* (No. 1768) on "Trapping and Transplanting Live Beavers", in which live-beaver traps are described and trapping methods and transport are discussed for the help of farmers, stockmen, foresters and others interested in beaver control.

An Air-Conditioning Unit

AN air-conditioning unit is usually a small cabinet, the only external evidence of its purpose being two small grilles. In *Engineering* of July 9, a description is given of one meant to stand on the room floor and placed near a window as the air inlet can then be readily arranged. It is about 40 in. high, 30 in. wide and 18 in. deep. It is electrically operated, and the supply cable can be plugged into any existing power point such as one used for a radio cabinet. With the air-cooled type this is all that is required, but with the water-cooled type connexions are needed with the water supply. In both summer and winter, the incoming air is first filtered; the inlet is a permanent fixture and does not interfere with opening the window for cleaning. Otherwise the window is kept closed to keep out the noise of street traffic. The fan is driven by a motor independent of the fans used for cooling and so can provide ventilation without either heating or cooling, if the outside air is in the desired condition. The cooling of the air and the removal of excess moisture by condensation is effected by a special refrigerator. The condensate is then re-evaporated and carried outside, so no drain-pipe is required in the air-cooled unit. For increasing the moisture in the air, the water in the humidifier tank is vaporized by an electric immersion heater. The relative humidity is settled by a hygrostat which automatically controls the heater. A small neon light indicates when the heating elements are working, and reminds the occupant to consider whether it is advisable to turn off the heat at night when leaving the conditioning plant running.

Atmospheric Pollution

THE twenty-second report on atmospheric pollution contains an account of observations for the year ending March 31, 1936 (London: H.M. Stationery Office, 1937. 6*s*. net). Reviewing the last twenty years, it is concluded that the effort and propaganda of the period have brought about an appreciable reduction in air contamination. This now seems to have ceased, or even changed to a slight rise, probably on account of the increased industrial activity. Again the figures for some London stations are very high, especially for sulphur. Westminster shows some of the highest figures, and compares very unfavourably with some of the industrial areas. In some cases, remarkable improvements have been rendered over a period of years, and the causes deserve scrutiny. The report is cautious in its interpretation, as the difficulty of sampling is obvious. At Burnley a fifty per cent fall has been recorded in ten years—attributed to the removal of a factory. Attention is directed to the high drop at Wakefield in total deposit, from 613 tons per square mile in 1924 to 227 tons in 1935. This may be associated with the persistent efforts made by the authorities there, and shows what is possible when those who wield political power treat seriously the problem of cleaner air. Unfortunately, it is only too rare that in local authorities the will and wish to improve the atmosphere are combined. The most important development recorded is the initiation of an intensive survey in and around Leicester—selected because it is relatively isolated from other industrial areas likely to prove disturbing factors.

Empire Conference on Tuberculosis

THE Minister of Health, Sir Kingsley Wood, delivered the inaugural address on May 3 at the Empire Conference on the "Care and After-care of the Tuberculous" at Overseas House, St. James's, London. He first reviewed tuberculosis as a cause of mortality in England and Wales. The standardized death-rate from this disease has fallen from 3,638 per million of population in 1851–55 to 687 in 1935; nevertheless, tuberculosis in this country still comes next to cancer in the list of killing diseases. Sir Kingsley next dealt with the public provision for the treatment of tuberculosis—29,000 beds in approved institutions—and the amount of expenditure thereon. He commended particularly the value of village settlements for treatment and after-care, and emphasized the importance of the after-care of patients who did not enter a village settlement.

Tuberculosis (Attested Herds) Scheme

THE Minister of Agriculture and Fisheries has amended the Tuberculosis (Attested Herds) Scheme (England and Wales) dated January, 1935, by the issue of a revised scheme, which came into force on June 1. The purpose of the new scheme, which adheres to the principles of the earlier one, is to encourage the addition of herds to the register of herds officially certified to be tuberculosis-free, by the offer of additional financial inducements to owners of cattle herds to qualify for a certificate of attestation. Further information in regard to the scheme may be obtained from the Secretary of the Ministry, Whitehall Place, London, S.W.1.

International Population Congress at Paris

UNDER the patronage of the International Union for the Scientific Investigation of Population Problems, a congress will be held in Paris for the discussion of these problems on July 29–August 1. The congress is organized by the French National Committee of the Union, under the presidency of M. Adolphe Landry, a former Cabinet Minister. Among the members of the organizing committee may be mentioned, MM. P. Rivet, J. Alquier, H. Bunle, A. Demangeon, M. Huber, R. Legendre, A. Siegfried and other distinguished workers in the field of demography. It is expected that there will be many representative delegations from a large number of countries. From Great Britain there will be members of the British Population Society, presided over by Prof. C. B. Fawcett, and of the Population Investigation Committee, presided over by Prof. A. M. Carr-Saunders, and others. America will send Prof. P. K. Whelpton, Dr. Warren S. Thompson and others. Delegations are also expected from Belgium, Czechoslovakia, Denmark, Germany, Holland, Hungary, Italy, Rumania, Sweden, and perhaps India and Japan.

THE subject-matter of the congress is divided into two main groups: quantitative problems, namely, historical demography, contemporary demography, including existing statistics, movements and international migrations, mortality, fertility and so on, and the resulting economic and social problems; and qualitative problems, namely, biometry, ethnology, transmission of characters, eugenics. Two questions are specially put forward for discussion, namely, (1) "De la meilleure méthode pour dégager et mesurer la tendance du mouvement naturel de la population"; and, (2) "La biométrie différentielle et la biotypologie, comme méthodes pour la classification des individus et des groupes". It is clear that the congress has plenty of work before it. It has been announced that the opening session will be honoured by the presence of the President of the French Republic, M. Albert Lebrun, and will take place at the Maison de la Chimie, 28 rue Saint-Dominique. All inquiries should be addressed to the Congrès International de la Population, 16 rue de l'Estrapade, Paris, V.

Leverhulme Research Fellowships

AMONG the list of Leverhulme Research Fellowships and Grants for 1937 are the following, who will carry out their researches at the places indicated:

RESEARCH FELLOWSHIPS: Prof. D. H. Bangham, professor of inorganic chemistry, Egyptian University, Cairo, the wetting of solid surfaces and the phenomena of spreading liquids thereon (Great Britain); Dr. D. Enid Charles, research fellow, Department of Social Biology, London, the mechanism of population decline with special reference to Scottish population problems (University of Aberdeen); Dr. C. W. Davies, senior lecturer in chemistry, Battersea Polytechnic, adsorption at liquid surfaces (University College, London); O. V. S. Heath, research worker, Institute of Plant Physiology, London, carbon assimilation by the green plant (Imperial College, London); Dr. J. de Graaff Hunter, late director, Survey of India, planning and execution of geodetic triangulation of great extent (renewal of present fellowship) (England); G. W. B. Huntingford, farmer, Kenya Colony, member, Nandi Land Trust Board, Government examiner in Nandi language, sociology of the Dorobo, a forest people of Kenya (Kenya); Dr. J. W. H. Lugg, biochemist, Imperial College, London, preparation and amino acid analysis of pasture plant proteins (Imperial College, London); J. P. M. Prentice, solicitor, meteors and meteor streams (England and North Africa); Dr. H. Scott, assistant keeper, Department of Entomology, British Museum, biogeographical research on the fauna of the highlands of South Western Arabia (Arabia); G. Seligman, chairman, British Group, International Commission of Snow, the transition of firn snow into glacier ice (Switzerland); Dr. H. W. Thompson, departmental demonstrator, Old Chemistry Department, University Museum, Oxford, correlation of data derivable from the spectra of polyatomic molecules with chemical problems (Pasadena).

RESEARCH GRANTS: Dr. D. Elliot Dickson, colliery surgeon, Lochgelly, Fife, occupational morbidity in coal miners (Scotland); Dr. E. M. Lind Hendricks, research worker, Imperial College, London, geological research in Cornwall (Cornwall); G. Manley, senior lecturer in geography, University of Durham, the helm wind of the Northern Pennines (England); Dr. R. E. Mortimer Wheeler, keeper, London Museum, origins in northern France of later prehistoric civilizations of Britain (France); Dr. M. Wilson, reader in botany, University of Edinburgh, a comparative study of the diseases of the Douglas fir in Europe and North America (Canada).

Beit Memorial Fellowships

THE following elections have been made by the trustees of the Beit Memorial Fellowships for Medical Research:

FOURTH YEAR FELLOWSHIPS (value £500 a year): Dr. R. P. Cook, to continue his research on cholesterol metabolism in reference to the cause of atheroma in blood vessels (at the Institute of Biochemistry, Cambridge); S. L. Cowan, to continue his research on the neuro-muscular transmission of nervous excitation (at the Department of Pharmacology, University College, London); Dr. D. E. Green, to continue his studies on intracellular enzymes and on the influence of vitamin B on oxidation processes (at the Institute of Biochemistry, Cambridge); Dr. M. Jowett, to continue his study of the action of narcotic drugs on the metabolism of the central nervous system (at the Biochemical Laboratory, Cardiff City Mental Hospital).

JUNIOR FELLOWSHIPS (normal value £400 a year): I. A. Anderson, for research on iron analyses of diets of women of the poorer classes at Aberdeen, and studies on the treatment of anæmia (at the Metabolic Research Laboratory, Aberdeen Royal Infirmary); Dr. D. Beall, for work on sterol metabolism, with special reference to sex hormones (at the Department of Pathology, British Postgraduate Medical School, London); J. G. Chalmers, for work on the role of polycyclic hydrocarbons in experimental tumour production (at the Glasgow Royal Cancer Hospital); Dr. F. C. Courtice, to study the influence of insulin and endocrine secretions on the metabolism of prolonged muscular exercise (at the Physiology Laboratory, Oxford); H. Davson, to study the cause of primary chronic glaucoma of the eye) at the Department of Physiology and Biochemistry, University College, London; Dr. T. R. R. Mann, for research on intracellular compounds of blood pigment and the metabolism of oxalic acid in mammalian tissue (at the Molteno Institute, Cambridge); Dr. Antoinette Pirie, to study the metabolism of filterable organisms by analysis of their enzyme systems (at the Institute of Biochemistry, Cambridge); Dr. D. Richter, for work on the action of adrenaline and related substances on the metabolism of individual organs (at the Institute of Biochemistry, Cambridge).

Travelling Fellowships in Tuberculosis

The Medical Research Council has awarded Dorothy Temple Cross research fellowships to the following, who intend to study problems of tuberculosis at centres abroad, during the academic year 1937–38: Dr. B. C. Thompson, formerly assistant tuberculosis officer, Durham County Council (renewal of present fellowship for three months); R. H. R. Belsey, resident surgical officer, Hospital for Consumption and Diseases of the Chest, Brompton, London; Dr. B. M. Maxwell, senior assistant medical officer, Cheshire Joint Sanatorium, Market Drayton; O. S. Tubbs, chief assistant to a Surgical Unit, St. Bartholomew's Hospital, London; Dr. Enid M. Williams, assistant lecturer in tuberculosis, Welsh National School of Medicine, Cardiff.

British Empire Cancer Campaign

The quarterly meeting of the Grand Council of the British Empire Cancer Campaign was held on July 12. On the recommendation of the Scientific Advisory Committee, the following grants were approved: £500 to Dr. P. M. F. Bishop, at Guy's Hospital, for the expenses for one year of certain investigations in regard to endocrine therapy in relation to cancer; £250 to Prof. G. I. Finch, at the Imperial College of Science and Technology, for the expenses of an investigation, on behalf of the Scientific Advisory Committee, into the nature and structure of carcinogenic compounds; and £160 to Dr. P. R. Peacock, at the Glasgow Royal Cancer Hospital, for the purchase of special apparatus for the continuation of his cancer research. On the recommendation of the Joint Committee of the Campaign and of Mount Vernon Hospital, Dr. G. Cranston Fairchild was reappointed the William Morris research fellow in radiology at that Hospital for a further period of one year. The William Morris research fellowship was established five years ago by a generous donation of a capital sum of £25,000 by Lord Nuffield.

Occultations of Mars and Venus

If the evening sky is clear on July 17, an interesting observation can be made without a telescope (though, preferably, slight optical aid is desirable) of the occultation of the planet Mars by the moon. The disappearance of Mars, as seen from a station near Greenwich, takes place at the moon's dark limb (the age of the moon being 9·7 days) at position angle 53° from the north point of the disk, measured eastwards, at 21^{h} 13^{m} U.T. (22^{h} 13^{m} Summer Time). The reappearance of Mars at the moon's bright limb is at position angle 326° at 22^{h} 10^{m} U.T. or 23^{h} 10^{m} Summer Time. The apparent diameter of Mars is about 14″ and its stellar magnitude − 0·8. A map in the B.A.A. Handbook for 1937 gives the limits on the earth's surface of the visibility of this occultation. The occultation of Venus by the moon on August 3 takes place in full daylight and cannot, in any event, be seen from southern England. The southern limit of visibility of partial occultation, as given in *J. Brit. Ast. Assoc.*, March, p. 187, runs approximately between Hull, Bradford and a little north of Blackpool; the southern limit of total occultation runs from just south of Bridlington, to Borough Bridge and just north of Carnforth. At Edinburgh, the disappearance of Venus is due at 8^{h} 26^{m} U.T. at position angle 159° from the north point of the moon's disk, and the reappearance at position angle 212° at 9^{h} 1^{m} (add 1^{h} to convert to Summer Time). The phenomenon will require telescopic aid generally, though Venus can on occasions be 'picked up' in daylight by keen-sighted observers. The moon's age is 26·2 days, so that the crescent is a very narrow one. Venus is in its gibbous phase, the ratio of the illuminated area of the disk to that of the entire apparent disk (17″ in diameter) being 0·67. Its stellar magnitude is − 3·6. The position of Venus on August 3 at 9^{h} is R.A. 5^{h} $53^{m}\cdot 0$; Dec. + 21° 20′.

A New Comet (1937 f)

A new comet was discovered on July 4 not far from the star, β Persei (Algol), by Mr. Finsler at Zurich. At discovery, the comet was diffuse without a central condensation of nucleus, but two days later, according to an observation made at Barcelona, a nucleus was observed as well as a short tail somewhat more than 1° in length. The *International*

Astronomical Union Circular No. 664 from Copenhagen gives elements of the comet derived from observations made at several observatories from July 4 to July 7. Independent elements of the comet's orbit are derived by Möller (Copenhagen), Kwiek (Poznań) and Cunningham (Harvard). These elements give the time of perihelion passage, respectively, as August 12·435, 11·139 and 14·52 U.T. The ephemeris derived from Möller's elements gives the position of the comet at 0^h U.T. on July 14, 18 and 22 as follows:

	R.A.	N Decl.
July 14	3^h $17{\cdot}5^m$	45° 43′
18	3^h $25{\cdot}6^m$	49° 59′
22	3^h $39{\cdot}1^m$	55° 31′

Dr. Steavenson has already observed this comet, which promises to be an interesting object. Its present magnitude is 7, but the decrease in its present heliocentric and geocentric distances, 1·05 and 1·25 units respectively, will probably cause a considerable increase in brightness.

Announcements

The first award of the Johannes Schmidt Medal has been made to Mr. Henry G. Maurice, fisheries secretary of the Ministry of Agriculture and Fisheries, and president of the International Council for the Exploration of the Sea, in recognition of his great services to international oceanographical and fisheries research. Most appropriately the presentation, by H.R.H. Prince Waldemar of Denmark, was made in the new offices of the Council in Charlottenlund Slot, on the occasion of the thirteenth annual meeting of the Council, which was held on July 5–10.

In connexion with the centenary celebrations of the University of Athens (see Nature, May 1, p. 749), the honorary degree of doctor of science was conferred upon Sir Napier Shaw, formerly director of the Meteorological Office and honorary president of the Commission for the Exploration of the Upper Air.

The following officers have been elected to the Council for the year 1937–38 of the Institution of Electrical Engineers: *President*, Sir George Lee; *Vice-Presidents*, Sir Noel Ashbridge, Mr. J. R. Beard; *Hon. Treasurer*, Mr. W. McClelland.

The following, among others, were granted Civil List pensions during the year ended March 31, 1937: Mrs. Jessie Bennett, in recognition of the services rendered by her husband, the late Mr. Arthur Bennett, to botanical science (£60); Dr. Maurice Copisarow, in recognition of his services to science, and in particular to chemical research (£130); Mrs. Elizabeth MacKenzie, in recognition of the services rendered by her husband, the late Mr. Donald MacKenzie, to the study of anthropology, mythology and folk-lore (£70).

The following appointments have recently been made in the Colonial Service: R. A. Wright, veterinary officer, Malaya; R. J. A. W. Lever (entomologist, British Solomon Islands Protectorate), entomologist, Fiji; C. Swabey (assistant conservator of forests, Trinidad), forestry officer, Jamaica; K. J. Johnston (superintendent of surveys), assistant surveyor general, Ceylon; A. V. Lawes (surveyor, Tanganyika), surveyor, Gold Coast; H. M. W. Nicholson (assistant pharmacist), pharmacist, medical department, Tanganyika; H. F. Rainsford (staff surveyor, Tanganyika), computer, survey department, Uganda; W. F. Wegener (assistant chief mechanical engineer), chief mechanical engineer, Federated Malay States Railways; W. W. Williams (assistant superintendent), superintendent of surveys, Ceylon; L. G. O. Woodhouse (assistant surveyor general), deputy surveyor general, Ceylon.

Prof. Paul Montel, professor of the theory of functions and theory of variability at the Sorbonne, has been elected a member of the Section of Geometry of the Paris Academy of Sciences, in succession to the late Prof. E. Goursat.

M. Léon Guillet, director of the École Centrale des Arts et Manufactures, and professor at the Conservatoire des Arts et Métiers, Paris, has been nominated an honorary vice-president of the Iron and Steel Institute.

Profs. Jules Bordet, director of the Pasteur Institute of Brussels, and Pierre Nolf, president of the Red Cross, have been awarded the Grand Cross of the Order of Leopold.

Dr. Rufus Cole, director of the Hospital of the Rockefeller Institute for Medical Research since 1909, has retired. His successor is Dr. Thomas Milton Rivers, who has been a member of the board of scientific directors of the International Health Division of the Rockefeller Foundation since 1927.

The Paul Appel Prize and Gold Medal of the Renaissance française, for the best contribution in recent years to the campaign against social scourges, has been awarded to the French League against Cancer for the "Index Analyticus Cancerologicus", commenced eleven years ago under the scientific direction of MM. Forgue, de Nobile, Hartmann, Rogard and Roussy. The recipients of the prize are MM. Lacassagne and Lavedan, general secretaries of the League.

A "Catalogue of Books and Journals on Zoology, Biology and Geology" (No. 507) for sale by W. Heffer and Sons, Ltd., Cambridge, contains 1,886 items. General works and scientific journals are well represented, as also are the groups dealing with entomology, ornithology and geology.

In connexion with the notes on national and international standardization in Nature of July 3, p. 19, we are asked to state the Survey to which they refer can be obtained from the Central Office of the World Power Conference, 36 Kingsway, London, W.C.2, price 3*s*. 6*d*., or 3*s*. 8*d*. post paid; copies may also be ordered through any bookseller.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 114.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Production of Positron and Electron Pairs by Bombardment of Mercury with β-Particles of Low Energy

SKOBELZYN and Stepanowa[1] have reported the production of positrons when β-particles of energy 1–3 MV. impinge on solid lead. In order to conserve electric charge, the phenomenon must have involved the production of a pair of positive and negative electrons. Examination of about a thousand photographs of the tracks of β-particles from radium E in a mixture of 5 per cent mercury dimethyl vapour and 95 per cent nitrogen, in a Wilson chamber, has rather surprisingly yielded two definite cases of the production of pairs of positrons and electrons by β-particles of energy just greater than 1 MV. It is quite clear that phenomena of this kind would be very difficult to detect unless the bombarded element was in gaseous form. Measurement of the best pair gave the following result, where E_β is the kinetic energy of the incident β-particle:

MV.					
E_β	E_+	E_-	ψ_+	θ_-	$(\psi_+ + \theta_-)$
1·10	∼0·15	0·013	48°	77°	125°

The energy of the electron was determined from its range, that of the positron from its radius of curvature. The latter could not be determined with great accuracy owing to the shortness of the illuminated portion of the track, but energy appears to be approximately conserved. The absence of a second negative electron track at the point of creation of the pair is of considerable interest. Its energy, after escape from the nucleus, may have been less than 2,000 volts, rendering the track of the particle undetectable; but the possibility of absorption by the nucleus must not be left out of account.

The total length of track of β-particles between 1 MV. and 1·3 MV. was about 40 metres and the effective cross-section of the mercury nucleus would accordingly be about 10^{-22} cm.^{2}. Statistical fluctuations would prevent any great reliance being placed upon this figure, but it is in approximate agreement with that deduced by Skobelzyn and Stepanowa. Previous results[2] have shown that not one pair is produced in 200 metres of similar track in nitrogen. It would therefore appear that the probability of pair production by β-particles of low energy (*a*) increases rapidly with the atomic number, (*b*) is large in the region $E_\beta \sim 2mc^2$. Unfortunately, there does not seem to be as yet any theoretical treatment of the production of pairs by a β-particle which has itself a kinetic energy just greater than $2mc^2$.

It is plausible that there may be also an 'internal production' of pairs by the nuclear β-particles. Possibly a part of the γ-radiation from radium E, found by G. H. Aston[3], may arise from the annihilation of the positrons formed by the internal conversion of the β-rays of energy greater than $2mc^2$. If this effect is at all appreciable, it will have to be taken into account in interpreting experimental data on the energy distribution in continuous β-ray spectra, since it would lead to a preferential weakening above 1 MV. and a corresponding increase in the region of low energies.

F. C. CHAMPION.
A. BARBER.

Wheatstone Laboratory
King's College,
London.
June 14.

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[1] *J. de Phys. et le Radium*, **6**, 1 (1935).

[2] Champion, *Roy. Soc. Proc.*, A, **153**, 353 (1936).

[3] *Camb. Phil. Soc. Proc.*, **23**, 935 (1927).

Porphyrins of the I and III Series in Congenital Porphyrinuria

As the result of a detailed chemical examination carried out *post mortem* upon a bovine suffering from congenital porphyrinuria[1], and my paper appearing in the *Onderstepoort Journal of Veterinary Science* (vol. 7, No. 2), I have been able to isolate porphyrins similar to those found by Fischer[2] and his collaborators in the human porphyrinuric 'Petry', but in addition have also obtained coproporphyrin, ester m.p. 243–44°, from the *blood plasma* and of m.p. 241° from the washed *erythrocytes*; both uroporphyrin, ester m.p. 276–77°, and coproporphyrin, ester m.p. 244–45°, from the *bone marrow*; uroporphyrin, ester m.p. 278°, from the *spleen* and uroporphyrin together with its copper complex, ester m.p. 313°, from the *liver*.

The isolation of coproporphyrin I from the blood is important as supplying a basis of explanation for the photosensitivity exhibited by the animal.

The melting points of the uroporphyrin esters, including those from the bones and urine, approximated to 278°, whilst Fischer reported 293° for pure uroporphyrin I, thus suggesting that a mixture of isomers might be present. This suspicion was enhanced by the isolation from the mother liquors of the crystallization of the bone product of a uroporphyrin ester with m.p. 253–55°. A scheme of chromatographic separation of the I and III series porphyrin isomers has been worked out using a column of alumina and dioxan as the solvent. A note upon the separation of uroporphyrins from urine and bones in these cases into I and III series isomers is attached as an appendix to my publication, already referred to, which is in the press. The bile coproporphyrin (m.p. 237°), after similar treatment melted at 246–48°, whilst a trace of pigment remaining in the column was found also to have a coproporphyrin spectrum; the quantity was insufficient for crystallization.

Whilst this work was in progress, Fischer, in a note appended to a paper by Fischer and Libowitzky[3], claimed that such a separation of uroporphyrin (m.p. 286°) from the Petry case into uroporphyrin I and uroporphyrin III had been effected in his laboratory by a chromatographic technique which was not described. No coproporphyrin specimens were examined. A paper by Fischer and Hofmann[4] has now appeared in which their technique is described, using talcum and chloroform-methyl alcohol.

It would appear highly probable that small quantities of series III pigments accompany those of series I excreted by congenital porphyrinurics. The uroporphyrin of acute idiopathic porphyrinuria has recently been shown to be uroporphyrin III by Waldenström[5] and by Mertens[6] (m.p. 255–58°). Any theory seeking to explain these diseases must now take cognizance of these facts.

The various forms of porphyry are probably brought about by failure of, or interference with, a particular aspect of the hæmoglobin synthetic mechanism, as is suggested in my forthcoming paper. The *site* of interference serves to determine which isomer is excreted in quantities above the normal.

Claude Rimington.

Onderstepoort Veterinary
Research Laboratory,
Pretoria,
South Africa.
May 4.

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[1] Nature, **139**, 68 (1937).

[2] Fischer, Hilmer, Lindner and Putzer, *Z. physiol. Chem.*, **150**, 44 (1925).

[3] Fischer and Libowitzky, *Z. physiol. Chem.*, **241**, 220 (1936).

[4] Fischer and Hofmann, *Z. physiol. Chem.*, **246**, 15 (1937).

[5] Waldenström, *Deut. Archiv. klin. Med.*, **178**, 38 (1935).

[6] Mertens, *Z. physiol. Chem.*, **238**, 1 (1936).

Retention of Radioactive Substances in the Body of Rats and the Lethal Dose

Therapy by radioactive substances introduced directly into the organism is limited only to a small number of elements, as the use of radioactive salts deposited permanently in the bones proved to be dangerous[1]. For this reason only two elements have been studied, namely, radon and polonium, with regard to their retention in the organism and quick elimination by means of various vehicles. Experiments were carried out with rats, the weight of which varied from 66 gm. to 290 gm. The present communication deals with the results obtained with radon only. A physiological solution, namely, a 10 per cent solution of glucose or emulsion of tungsten in olive oil, is used as vehicle. The rats received an injection of a maximum dose of 1 c.c. of these substances either subcutaneously or intermuscularly. The solutions were activated with radon in such a manner that the activity of one injection was 0·5–14 millicuries. The rate of elimination of radon from the body of the rats was measured electrometrically by the method of gamma rays of the active deposit of radon.

The results were as follows:

(1) In the case of physiological solution and glucose, radon is eliminated from the body of rats at the same rate, irrespective of the method of injection (intermuscular or subcutaneous), in a period of 30 minutes, which coincides with the period of elimination of radon ascertained in drinking and inhalation cures.

(2) In the tungsten emulsion radon is bound more permanently, 67 per cent of the initial dose injected remaining after two hours, whereupon it is eliminated in a period of 100 minutes.

(3) The elimination of radon with each of the vehicles is effected mainly by breathing.

(4) Even a dose of 14 millicuries is not capable of killing, and does not even disturb any of the basic vital functions.

(5) In the case of tungsten emulsion, an approximate calculation of energy of alpha rays absorbed in the organism, which constitute almost entirely the physiological effect of the injected radon, was carried out. The maximum dose of 14 millicuries gives about 17×10^6 ergs of energy absorbed, which, compared with gamma rays, would correspond to irradiation with the quantity of one gram of radium (with soft gamma rays absorbed) attached directly to the body of the animal for a period of about 30 minutes.

(6) In the case of polonium injections, on which a separate report will be made, the lethal dose was reached at an average absorbed energy of about 6×10^6 ergs. This energy was absorbed at a much lower rate than the maximum energy supplied by radon, which proves that the effect of equal doses of radioactive radiation grows with the period of its duration.

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F. V. Novák.

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[1] Summarized report: Evans, R. D., *Amer. J. Public Health*, **23**, 1017 (1933); Laborde, S., *Presse méd.*, Nr. 95 (1936).

Nature of the Diffusion Process in Rubber

It is known[1,2], that silica-gas diffusion systems exemplify a type of non-specific activated diffusion process, as opposed to the specific type of diffusion system such as hydrogen-palladium. It seemed that the diffusion of gases through other 'glass-like' materials such as some organic membranes, for example, rubber, might offer further examples of

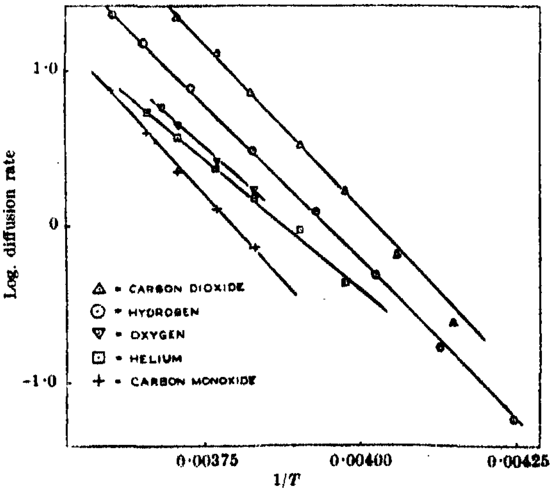

Fig. 1.

Diffusion through pure para-rubber (Dewar's data). Diffusion rate in c.c./day/cm.^{2}/atmosphere; thickness of membrane, approximately 1 mm.; T = absolute temperature.

non-specific activated diffusion. The data needed to test this hypothesis were available in papers by Edwards and Pickering[3], and by Dewar[4]. Graham[5] first noted the large temperature coefficient of the diffusion process through rubber, and that the diffusion velocities had no connexion with the molecular weights.

Edwards and Pickering's data for the diffusion of hydrogen, helium and carbon dioxide through vulcanized rubber, and Taylor, Hermann and Kemp's data[6] for the diffusion of water through vulcanized rubber, give good straight lines when log (diffusion rate) is plotted against the reciprocal of the absolute temperature (*T*), with the exception of the data for carbon dioxide at temperatures of 80° and 100° C. Similarly Dewar's data (Fig. 1) for diffusion of hydrogen, helium, carbon monoxide, carbon dioxide and oxygen through pure *para*-rubber, give linear log (diffusion rate) *vs* $1/T$ curves. Energies of activation calculated from these curves for vulcanized and for para-rubber are given in the accompany table. They are very much larger for the pure para-rubber than for the vulcanized rubber.

VULCANIZED RUBBER			PARA RUBBER		
Gas	Energy (cal./mol.)	Author	Gas	Energy (cal./mol.)	Author
He	6,300	Edwards and Pickering	He	15,400	Dewar
H_2	6,470	,,	H_2	19,000	,,
	5,900	Daynes[7]			
CO_2	7,580	Edwards and Pickering	CO_2	19,100	,,
H_2O	2,780	Taylor, Hermann and Kemp			
			O_2	16,300	,,
			CO	19,000	,,

The solubility of these gases in rubber varies only slightly with temperature[8], so that no explanation save one involving activated diffusion can account for the velocity *increasing* exponentially with temperature.

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May 29.

[1] Alty, *Phil. Mag.*, **15**, 1035 (1933).

[2] Barrer, *J. Chem. Soc.*, 378 (1934).

[3] Edwards and Pickering, *Sci. Papers. Bureau of Stds.*, **16**, 327 (1920).

[4] Dewar, *Proc. Roy. Inst.*, **21**, 813 (1914–16).

[5] Graham, *Phil. Mag.*, **32**, 401 (1866).

[6] Taylor, Hermann and Kemp, *Ind.-Eng. Chem.*, **28**, 1255 (1936).

[7] Daynes, *Proc. Roy. Soc.*, A, **97**, 286 (1920).

[8] Wroblewski, *Wied. Ann.*, **8**, (1879).

Nitric Oxide and Alkyl Ethers

THE reaction of *dimethyl ether* and *nitric oxide* has been investigated in some detail by Dr. P. F. Gay and myself[1], and whatever the mechanism of the secondary reaction which follows the suppression of the main decomposition process may be, *it* seems to be quite clear that it cannot be the one represented by the equation,

$$NO + CH_3 \rightarrow CO + NH_3,$$

since the ratio, $(CO + CO_2)/CH_4$, in the product is the same as when nitric oxide is absent from the system. What does happen is that the ratio CO_2/CO is greater when nitric oxide is present than when it is absent, and in the presence of nitric oxide the product contains very little free hydrogen. It seems likely, therefore, that the mechanism suggested by Dr. Gay and myself[2] explains the effect of the nitric oxide better than that put forward by Messrs. Thompson and Meissner in NATURE[3] of June 12.

I may point out that nitrous oxide is also certainly a product of the process, and it is interesting to note that ammonia, or an amine, is also formed. However, the significance of this observation will only be arrived at by quantitative study of an exacting character, which will be difficult.

As Dr. Gay and I have pointed out, the interaction of nitric oxide and the ethers is a particular instance of a common phenomenon involving the retardation or suppression of one process and the acceleration or initiation of another. Similar reactions have been studied in this laboratory.

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June 16.

[1] *J. Faraday Soc.*, **33**, 768 (1937).

[2] NATURE, **138**, 546 (1936).

[3] NATURE, **139**, 1018 (1937).

Structure and Resistance of Thin Metal Films

IT was proposed by Kramer[1] that a film below a certain '*transition temperature*' is *mainly* amorphous, though containing some regions of normal metal, and that at the transition temperature the film is converted completely into the normal crystalline metal. The transition temperature was given by an empirical formula in terms of atomic volume, conductivity, and the number of free electrons per atom (*N*) in the normal metal. Structural changes have been shown to occur by different investigators[2], and have been discussed by them and others[3]. It has not always been observed that the structural changes occur at a sharply defined critical temperature, and theories alternative to that of Kramer have been proposed.

It does not appear to have been remarked that the resistance-temperature curve shown by Cosslett[4] indicates a transition temperature at about 10° C. for indium. If we take for indium $N = 3$, then Kramer's formula indicates a transition temperature of 282° K., which is in excellent agreement with Cosslett's curve. Kramer takes $N = 3$ for aluminium, which would justify the use of $N = 3$ for indium, although Hume-Rothery prefers $N = 1$ in each case[5]. The transition temperature of 282° K. would not agree with the recent proposal of Fukuroi[6] that the 'recrystallisation' temperature is 0·4 multiplied by the melting point, since the melting point of indium is 428° K., and the zero-thickness transition temperature would be higher than 282° K.

On the other hand, this agreement with Kramer's theory may be fortuitous, since, setting $N = 1$ in his formula, we obtain for rubidium and cæsium transition temperatures of 80° K. and 117° K. respectively. The work of Lovell[7] on rubidium covered the range 64°–90° K., and showed not only no transition point but a resistance-temperature curve with a positive slope, while cæsium[8] showed similarly a positive slope, which would not be expected below the transition temperature.

It seems possible that the existence of a sharp transition temperature may be associated with the desorption of gas from a film originally formed under poor vacuum conditions, or on a substrate not free from gas, owing either to the existence of a critical temperature for gas desorption or to a delay of recrystallization owing to the presence of gas. That gas may be important under high vacuum conditions (10^{-7} mm.) has been shown here in work on the high-frequency resistance of thin molybdenum films deposited on glass. High-frequency resistance is insensitive to large-scale structural changes, for example, to formation of cracks and fissures, and even to the formation of 'windows'[9]. Nevertheless, there is an increase in film resistance with time unless the glass has been thoroughly degassed by prolonged baking.

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May 31.

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[1] Kramer, *Ann. Phys.*, **19**, 37 (1934).

[2] Gen. Zelmanoff and Schalnikoff, *Phys. Z. d. Sowjetunion*, **4**, 825 (1933). Perucca, *Z. Phys.*, **91**, 660 (1934). Suhrmann and Barth, *Z. Phys.*, **103**, 133 (1936). Cosslett, *Proc. Phys. Soc.*, (2), **49**, 121 (1936).

[3] Tamman, *Ann. Phys.*, **22**, 73 (1935). Vand, *Z. Phys.*, **104**, 48 (1936).

[4] Cosslett, *Proc. Phys. Soc.*, (2) **49**, 121 (1936).

[5] Hume-Rothery, "Metallic State", p. 326 (Oxford, 1931).

[6] Fukuroi, NATURE, **139**, 884 (1937).

[7] Lovell, *Proc. Roy. Soc.*, A, **157**, 311 (1936).

[8] Appleyard and Lovell, *Proc. Roy. Soc.*, A, **158**, 718 (1937).

[9] Andrade, *Phil. Trans. Roy. Soc.*, A, 235, 69 (1935).

Principle of the Cartesian Diver applied to Gasometric Technique

IF for some reason or other the quantity of gas in a Cartesian diver decreases or increases, the pressure necessary to bring the diver to a standstill at a fixed level will change correspondingly, that is, the pressure change will be a measure of the change in quantity of gas. If, therefore, within the diver processes take place involving liberation or absorption of gas, the rate of these processes may be estimated quantitatively by measuring at different times the pressures at which the diver is in (unstable) equilibrium at a fixed level.

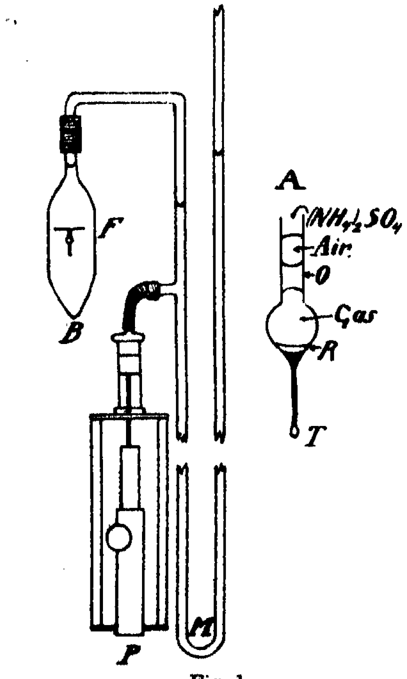

Fig. 1.

Fig. 1 shows how this may be done on an ultra-micro scale. *A* is a diver of the simplest type and with a gas volume of approximately 10 c.mm. In the bottom of the bulb 1 c.mm. of reaction mixture (*R*) is placed, and in the neck there is a small stopper of paraffin oil (*O*). *T* is a glass tail which serves as a weight to maintain the diver in a vertical position and to regulate its equilibrium pressure at a value close to that of the atmosphere. The diver is placed in a vessel *B* filled with saturated ammonium sulphate (to reduce gas exchange to a minimum without increasing viscosity). *B* is submerged in a well-regulated thermostat (± 0·02°) and connected with the manometer *M* and pressure adjuster *P*. The latter consists of a syringe the piston of which is moved by means of a rack. The manometer and the syringe are filled with water. By pressing the piston up and down it is possible to bring the diver to a temporary standstill at the mark *F*, and the corresponding pressure observed on the manometer is reproducible within 0·2 cm. water. Since this uncertainty is 0·02 per cent of the total pressure (about 1 atm.), any variation of the quantity of gas within the diver may be measured with an accuracy of $\frac{10 \times 0\cdot02}{100}$ c.mm.

Furthermore, the equilibrium pressures of two different divers kept in two different vessels for a period of 24 hours will not change mutually by more than 0·2 cm. water.

The principle has been successfully applied to the study of choline esterase activity using the Warburg technique (change of carbon dioxide tension over bicarbonate buffered reaction mixtures). But it is also applicable to the study of respiration and generally in many cases where gasometric analysis is used.

Details and applications will be described in subsequent papers.

K. LINDERSTRØM-LANG.

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May 19.

On Bremsstrahlung

THE method previously used[1] to calculate the cross-section for pair production by a beam of γ-rays has been extended to deal with transitions of a Dirac electron between two states of positive energy in a Coulomb field. It is thus theoretically possible to obtain an exact evaluation of the differential cross-section for energy loss by radiation of an electron incident on an atomic field (neglecting screening, which is justifiable for the energy values used). Actually, owing to difficulties of computation, the calculation is only practicable for fairly slow electrons losing more than half their kinetic energy in the field of a heavy nucleus. This is the case in which the values calculated by the use of Born's approximation[2] may be expected to be least reliable. The numerical work involved in the exact solution is too heavy to allow a full survey of the low energy region, so in order to check the Born values in this region the differential cross-section (per unit energy range of the final state) has been calculated in two particular cases, for lead ($Z = 82$) for an incident electron of total energy $E_0 = 3mc^2$, losing energy $h\nu = 1{\cdot}5mc^2$ and $1{\cdot}95mc^2$.

The cross-sections Φ are given for these two cases and for comparison the values obtained using the Born approximation are inserted (Bethe and Heitler, *loc. cit.*, eqn. (15)).

Energy loss	$1{\cdot}5mc^2$	$1{\cdot}95mc^2$
$\Phi \times 10^{24}$	13	8
$\Phi \times 10^{24}$ (Born)	9·9	1·8

The values given should be correct to about 10 per cent. It appears that in this case the Born approximation gives fairly good results, except towards the short wave limit, $h\nu \rightarrow E_0 - mc^2$, where it is much too low. This is to be expected, as the wave function of the electron in the final state can no longer be regarded as an approximately plane wave.

As suggested by Heitler[3], it can also be shown that for the Dirac electron, as in the non-relativistic theory of Sommerfeld, the cross-section approaches a finite value at the short wave limit. We may expect that, as in the analogous case of pair production by a beam of γ-rays[4], the error of the Born values will decrease rapidly with increasing E_0 and decreasing atomic number, except near the short wave limit.

Comparison with experiment is as yet impossible, but it may be noted that Klarmann and Bothe[5], using electrons of mean total energy about $3{\cdot}5mc^2$ scattered in xenon and krypton, have obtained results indicating energy losses about 3–5 times those given by the Born approximation.

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University of Tasmania.

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[1] Jaeger and Hulme, *Proc. Roy. Soc.*, A, **158**, 443 (1936).

[2] Bethe and Heitler, *Proc. Roy. Soc.*, A, **146**, 83 (1934).

[3] "Theory of Radiation", p. 171.

[4] NATURE, **137**, 781 (1936).

[5] *Z. Phys.*, **101**, 489 (1936).

Absorption Spectra Evidence of the Decomposition of the Ground Term of Nd+++ Ion due to Crystalline Fields

PARAMAGNETIC ions in crystals are subject to electrostatic crystalline potentials the symmetry properties of which depend mainly on the local arrangement of other atoms around the ion. For example, six oxygen atoms grouped octahedrally around the ion, as in $NdCl_3.6H_2O$ and $Nd_2(SO_4)_3.8H_2O$, give rise to a field of cubic symmetry of the type $D(x^4 + y^4 + z^4)$. A general method for determining the decomposition of the energy levels of the ion in such a field has been worked out by Bethe[1], and Van Vleck[2] has utilized this theory to account for the broad features of the temperature variation of the magnetic susceptibility of crystals. Penney and Schlapp[3] have considered the rare earth salts in detail. From the temperature variation of the mean susceptibility, as measured by Gorter and de Haas, they find that the level $^4I_{9/2}$ of the free ion is split into three groups of levels at 0, 244 and 610 cm.$^{-1}$. Spedding[4], by direct spectroscopic measurements of the absorption spectra of this crystal, finds levels at 0, 77 and 260 cm.$^{-1}$. From these results the conclusion is drawn that the levels predicted by Schlapp and Penney are not found, but the levels actually observed have the same relative, but only one third overall, separation. Determining the value of the constants · in Penney and Schlapp's equations, Spedding finds that his results are in better agreement with the susceptibility measurements of Zernicke and James, and of Selwood.

I wish to report on the result of certain investigations carried out in my laboratory by Mr. P. C. Mukherji on the absorption spectra of crystals of $NdCl_3.6H_2O$, which are in good agreement with the predictions of Penney and Schlapp's theory. The detailed results are being published in the *Indian Journal of Physics*. It has been found that in the region of 5000 A., there is an absorption band consisting of seven intense lines, and accompanied on the longer wave-length side by a similar group of six faint absorption lines.

Strong lines	Weak lines	Interval
19,144 cm.$^{-1}$	18,897 cm.$^{-1}$	247 cm.$^{-1}$
19,095	18,852	243
19,082	18,820	262
19,035	18,788	247
19,001	18,752	249
18,972	—	—
18,940	18,691	249
	Mean	249 cm.$^{-1}$

On reducing the temperature of the crystal to that of liquid oxygen, it is found that while the sharpness of the faint components increases, their intensities diminish, so that they can be observed at the low temperature with a comparatively thick crystal only ($t = 2{\cdot}5$ mm.). The weak lines seem, therefore, to be due to transitions from a lower excited level of the ground term of the Nd+++ ion, and the observed frequency difference of 249 cm.$^{-1}$ seems to be in good agreement with the calculated value of 244 cm.$^{-1}$ found by Penney and Schlapp. This result appears to be a definite optical verification of the splitting up of a term in a crystalline field as calculated from purely magnetic data.

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April 28.

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[1] *Ann. Phys.*, **3**, 133 (1929).

[2] "Theory of Electric and Magnetic Susceptibilities" (Oxford, 1932).

[3] *Phys. Rev.*, **41**, 194 (1932).

[4] *J. Chem. Phys.*, **5**, 160 (1937).

THE interpretation of the absorption spectra of rate earth crystals, as given by Spedding and his collaborators[1], and by Prof. Bose in the above letter, to us seems too simple to be true. Spedding claims that his measurements on the absorption spectrum of crystals of the type $X_2(SO_4)_3.8H_2O$, where X is a rare earth element, can be quantitatively explained on the basis of a crystalline potential $D(x^4 + y^4 + z^4)$. In the case of Pr+++, for example, this potential by no means removes all the degeneracy of the lowest state, $^3H_4$, of the free ion, but gives a pattern consisting of a single, a doubly-degenerate, and two triply-degenerate levels. Spedding actually finds four low-lying levels, and identifies them with this pattern. As he points out, any terms in the potential function not of cubic symmetry will remove the degeneracy of the triple levels in first approximation, and the fact that no trace of such doubling or tripling can be detected, he takes to mean that terms other than those of cubic symmetry are practically absent.

The validity of the assumption of a crystalline field of almost perfect cubic symmetry can be tested with considerable accuracy by an appeal to magnetic data, since any deviation from cubic symmetry causes anisotropy in the paramagnetic susceptibility. At room temperatures, for the rare earths (anisotropy/mean susceptibility) must be of the same order as (splitting caused by non-cubic terms in a triply degenerate cubic level/overall splitting due to cubic field). Prof. K. S. Krishnan has kindly informed us that $Pr_2(SO_4)_3 . 8H_2O$ at room temperatures has an anisotropy roughly 10 per cent of the mean susceptibility[2]. Hence, separations of at least 50 cm.$^{-1}$ must be assumed between the various components of either of the two triply degenerate cubic levels of Pr^{+++} in order to account for the magnetic measurements. All nine levels of $J = 4$ should show up in absorption spectra, and the failure of Spedding to locate more than four may simply mean that at room temperatures these are the only ones with any appreciable population. Again, the explanation may very well lie in peculiar intensity rules, at present not understood.

We have made further calculations on the mean susceptibility and anisotropy of $Pr_2(SO_4)_3 . 8H_2O$, and the corresponding salts of neodymium and ytterbium. Roughly the same cubic fields, together with small rhombic terms give satisfactory agreement for Pr^{+++} and Yb^{+++}, and for Nd^{+++} at all but very low temperatures. At these temperatures, as pointed out by Van Vleck[3], small departures from cubic symmetry can only have the effect of *increasing* the susceptibility of Nd^{+++}, whereas the experimental results are considerably *lower* than those predicted by a field of cubic symmetry. We find that if the rhombic field is made sufficiently large to lower the mean susceptibility of Nd^{+++} to the observed value, all resemblance of the energy diagram to the cubic field pattern is lost.

Details will be published elsewhere.

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June 2.

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[1] Spedding, Hankin and Nutting, *J. Chem. Phys.*, **5**, 191 (1937), and earlier papers.

[2] Krishnan and Mookherji, to appear shortly in *Phil. Trans.*

[3] *J. Chem. Phys.*, **5**, 198 (1937).

Band Spectrum of Chromium Hydride, CrH.

CONTINUING our investigations of the spectra of the hydrides of the transition elements, we have now observed a band in the region 3600–3700 A. when running a high-tension arc between chromium electrodes in a flame of hydrogen burning in air.

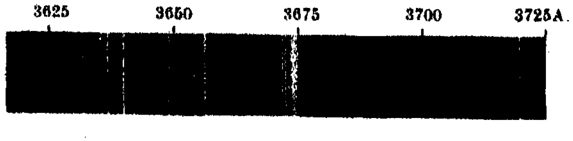

Fig. 1.

The method of production of this band is similar to that used by us to obtain the spectra of nickel hydride[1], NiH, and manganese hydride[2], MnH, and we attribute the new band to CrH. A spectrogram taken in the first order of a 20 ft. concave grating is reproduced in Fig. 1. The band is degraded to shorter wave-lengths, and the rotational structure is only partially resolved under this dispersion.

The chromium oxide, CrO, bands in the orange region of the spectrum were not observed under the conditions most favourable for the production of the new band, and it seems very unlikely, for experimental reasons, that the band can be due to anything except the hydride. The chromium atom has a ^7S level as its lowest state, and a high multiplicity, probably six, is therefore to be expected for the hydride; this would account for the complexity of the rotational structure of the band.

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[1] *Proc. Roy. Soc.*, A, **143**, 312 (1935).

[2] NATURE, **139**, 590 (1937).

Nuclear Moments of Aluminium

THE hyperfine structure of the lines $3\,^2P_{1/2} - 4\,S_{1/2}$ (3944 A.), $3\,^2P_{3/2} - 4\,S_{1/2}$ (3961 A.), $3\,^2P_{1/2} - 3\,^2D_{3/2}$ (3082 A.) and $3\,^2P_{3/2} - 3\,^2D_{5/2}$ (3093 A.) was investigated by means of the absorption in an atomic beam of aluminium. The structure of the lines $3\,^2P_{3/2} - 4\,S_{1/2}$ and $3\,^2P_{3/2} - 3\,^2D_{5/2}$ could not be resolved. The line $3\,^2P_{1/2} - 4\,S_{1/2}$ was found to possess three components at $-0{\cdot}048$, $0{\cdot}000$ and $+0{\cdot}048$ cm.$^{-1}$ of approximately equal intensity. The line $3\,^2P_{1/2} - 3\,^2D_{3/2}$ possessed two components, their separation being 0·062 cm.$^{-1}$; the intensity ratio of these two components was measured to a high degree of accuracy; the mean of eighty measurements gave the value 1·21, the component of longer wave-length being the stronger.

From the observed structure of the line $3\,^2P_{1/2} - 4\,S_{1/2}$, it follows that the levels $3\,^2P_{1/2}$ and $4\,S_{1/2}$ are both split into two levels, of separation 0·048 cm.$^{-1}$ (the greater splitting of the line $3\,^2P_{1/2} - 3\,^2D_{3/2}$ is due to a small unresolvable inverted structure of the level $3\,^2D_{3/2}$ which is probably caused by perturbation by the term $3\,s\,3\,p^2\,^2D_{3/2}$). The observed intensity ratio of the components of 3082 A. gives a value 9/2 for the nuclear spin, the theoretical value for a spin 9/2 being 1·22. The magnetic moment, calculated from Goudsmit's formula, is 4·1 nuclear magnetons according to the splitting of the level $4\,S_{1/2}$, and 3·6 nuclear magnetons according to the splitting of the level $3\,^2P_{1/2}$. The agreement between these two values is the more satisfactory as the formula for *p*-terms gives, according to Goudsmit, rather too low values for light elements.

The lines $4\,S_{1/2} - 5\,^2P_{3/2}$ (6696 A.) and $4\,S_{1/2} - 5\,^2P_{1/2}$ (6699 A.) were observed in emission; they were both doublets, only just resolvable on account of the Doppler width, of separation about 0·05 cm.$^{-1}$; the intensity ratio, when corrected for overlapping, was found to be about 1·23, the long wave component being the stronger. These observations are in agreement with the above conclusions.

This result is in disagreement with the contents of a preliminary note by Ritschl[1]; from an observed doublet hyperfine structure in the lines 3057 and 3050 of the arc spectrum and 2669 of the spark spectrum, he suggested a nuclear spin of 1/2; but he made no intensity measurements, and the observed doublet structures can be explained by incomplete resolution.

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[1] Ritschl, R., NATURE, **131**, 58 (1933).

Aggregation of Virus Particles

EVIDENCE confirming the description[1] by Bawden *et al.* of the shape of the tobacco mosaic virus particle appears in Best's recent photograph[2] of virus protein forming long threads after it has been precipitated from solution. Further evidence that virus particles, even in dilute solutions, may form chain aggregates is obtained from experiments on the relation between dilution of virus and number of infections caused.

Certain carefully purified preparations of virus[3] gave, on dilution, infection series which agreed closely with an equation of the form $y = N(1 - e^{-pn_1x})$, where y is the number of infections produced by an inoculum of relative concentration x, N is the asymptotic number, n_1 is the number of virus particles in the undiluted preparation, and p is the small probability of any one particle entering one of the N points in the plant tissue to cause an infection.

In the example given of a dilution series for a purified sample of tobacco mosaic virus (ref. 3, Table 1) there was a significant divergence from the values calculated from the equation; and the results since published by Stanley[4,5] for crystalline tobacco mosaic and aucuba mosaic proteins are widely divergent from calculated values. The number of infections increases less rapidly with concentration of virus than would be expected. In attempting to explain such divergences, we assumed that the virus particle was capable of combining reversibly with a particle of impurity to give an inactive complex. The relation between the concentration of effective virus particles, n_1x, and the total concentration, v_1x, is given by

$$(n_1x)^2 + n_1x\{k - v_1x(1 - q)\} - v_1xk = 0,$$

where q is the ratio of the number of particles of impurity to the number of virus particles and k is the dissociation constant of the complex. The special form of the equation which fitted the results was that when $q = 1$. This seemed to be a highly unlikely state of affairs. Search for a more likely hypothesis revealed the fact that the same equation is obtained if it is assumed that virus particles can join end-to-end to form chains, single particles or aggregates being infective units. If r is the number of junctions between particles, then using the above nomenclature,

$$r = v_1x - n_1x\,;$$

and if k_1 and k_2 are independent of chain length

$$k_1(n_1x)^2 = k_2r = k_2(v_1x - n_1x)$$
$$(n_1x)^2 + kn_1x - kv_1x = 0.$$

The infection-dilution data for a number of experiments with viruses of the tobacco mosaic group and Stanley's results with purified virus proteins[4,5] have been tested by applying this modifying equation. The former were obtained with virus preparations at various stages of purification, but in all cases the agreement between observation and calculation is sufficiently accurate to render it likely that end-to-end aggregation is the main cause of the divergence of the results from expectations based on the simpler picture of separate virus particles.

It may be expected that the modified picture will apply only to the tobacco mosaic group of viruses, which are thought to consist of rod-shaped particles[6], and this has so far been borne out by experiment.

These results are described more fully in a paper to be published in the *Australian Journal of Experimental Biology and Medical Science.*

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[1] Bawden, F. C. *et al.*, NATURE, **138**, 1051 (1936).

[2] Best, R. J., NATURE, **139**, 628 (1937).

[3] Bald, J. G., *Ann. Appl. Biol.*, **24**, 33 and 56 (1937).

[4] Stanley, W. M., *J. Biol. Chem.*, **117**, 325 (1937).

[5] Stanley, W. M., *Amer. J. Bot.*, **24**, 59 (1937).

[6] Bawden, F. C., and Pirie, N. W., NATURE, **139**, 546 (1937).

Production of Mutations by Neutrons

IN experiments to determine the possibility of producing mutations by treatment with neutrons, adult males of *Drosophila melanogaster* were subjected to a neutron bombardment derived from a 485 gm. block of beryllium exposed to the γ-rays from 4 gm. of radium. It is known that beryllium thus exposed produces neutrons of two velocities, the fast ones having an energy of 0·60 million electron-volts and the slow of 0·16 million electron-volts. Fast neutrons were used in one series of experiments, the very slow ones being excluded by means of a cadmium plate. In a second series, the fast neutrons were slowed down by passage through paraffin, so that only slow neutrons were used. In a third series, serving as a control, paraffin was substituted for the beryllium block, so that the flies received no neutrons but did receive the same gamma radiation and secondary radiation from the radium source as in the first two series. In these three series, a thick lead block was used to remove most of the radium γ-radiation. Finally, in a fourth series, serving as a second kind of control, the flies were not irradiated artificially in any way.

The ClB method of breeding was used, and the occurrence of all sex-linked lethals was noted. The table below gives the summarized results of the examination of the F_2 groups of flies (15,352 fertile cultures in all).

Series	No. of Groups of F_2	No. of lethals	Observed frequency of lethals
1. Fast neutrons plus escaping radium radiation	4312	44	1 in 98
2. Slow neutrons plus escaping radium radiation	1504	5	1 in 301
3. Escaping radium radiation without neutrons	4764	19	1 in 250
4. No irradiation	4772	12	1 in 398

It will be seen that although the radiation escaping from the radium source may have caused a few mutations, this by no means accounts for all the mutations arising in the flies treated with fast neutrons. On the other hand, the slow neutron series did not have an appreciable number of mutations produced in it, although, from a theoretical point of view, some production of mutations by this means also is to be expected.

The mutations produced by the fast neutrons probably result from the action of the recoil protons and other atomic nuclei, in producing ionization along their tracts. This effect then falls in line with that of gamma and X-rays, of fast electrons, of ultra-violet and of alpha rays, in producing mutations, being most nearly akin to that of the last-named agent.

A more detailed account of the physical arrangements and of the results obtained is in course of preparation. We wish to express our thanks to Prof. Edgar Altenburg, under whose encouragement and guidance on the genetic side the work was carried out. We wish also to thank the American Oncologic Hospital of Philadelphia for the use of its 4 gm. radium bomb.

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A Short Periodic Growth Cycle and a Secular Variation in *Lemna minor*

THE rate of frond production in *Lemna*, when grown under constant conditions in which light, temperature and culture solution were all controlled, was found to be only approximately exponential and certain deviations from the ordinary compound interest law have been established. First, there is a secular variation which takes the form of a wave with a 25–35 day cycle and, secondly, superimposed on the long variation is a short periodic cycle of 4–6 days. The short wave has been followed through 15 successive cycles in one experiment. The length of the cycle of the short, and possible also of the long wave, appears to be correlated with the mean rate of increase in frond number, in that when grown under conditions which give rise to a rapid rate of division the cycle is short, and vice versa.

Successive measurements of dry weight show a secular 'wave' as in the case of the rate of increase in frond number. The waves in both cases are of approximately equal lengths in any one experiment, but are opposite in phase. The presence of a *short* periodic cycle in dry weight determinations has not been definitely established, but the data available indicate its probability.

The experiments show that, while there is neither constancy in the dry weight per frond nor in the relative rate of increase in frond number, yet the rate of increase of total mass appears to be strictly exponential.

Little is known of the factors influencing the rhythmic increase in frond number and variation in dry weight, but they may be related to the fact that the growth data are those of colonies of numerous individuals, that is, that there is a social biological effect. This aspect of the matter is now undergoing investigation.

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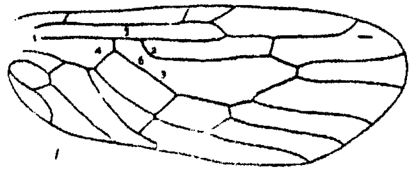
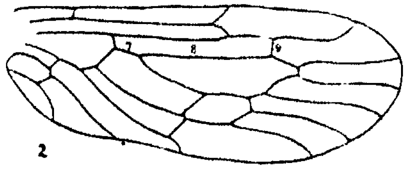
Graded Mutations in Wings of a Stonefly

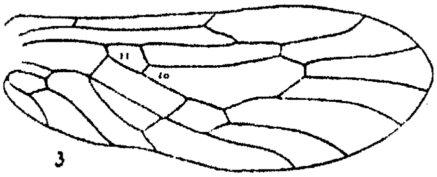
MORE than two hundred definable variants have been recognized in the wings of the variable stonefly, *Allocapnia pygmæa* Burmeister. Some of them were mentioned in a former paper[1]. The three following deviations are new and merit special reference. Figs. 1 and 2 are left and right forewings of the same female, the former nearly normal, the latter highly exceptional; Fig. 3 is the left forewing of another and Fig. 4 that of a third. Left wings are seen from below. In a typical plecopterous forewing (Fig. 1), the radial sector (2) arises directly from the radius (1) by its own radicle; it is separated from the arculus or basal anastomosis (4) by a radial internode (5) and from the median stem (3) by the basimedian passage (6). The hindwing is characterized, typically but not invariably, by a partial fusion of radial sector and median vein, which leave the arculus by a common mediosectoral pedicel. In *A. pygmæa* these veins issue separately from the arculus on an average of 8 per cent in five hundred hindwings.



1



2



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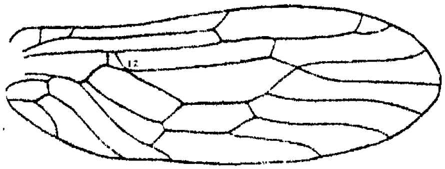

4

In two forewings from a sample of five hundred, there is a perfect mediosectoral pedicel (7) in the right forewing of one (Fig. 2), in the left of the other, so that there is no basimedian passage, no sectoral radicle, and the interracial cell (8) extends throughout the length of the discal area from the upper division of the arculus to the interradial crossvein (9). In several instances an adventitious mediosectoral basal crossvein (10) passes from the angle of the sectoral radicle across the intervening space to the median vein (Fig. 3), closing off a basimedian cell (11) from the median basin. This crossvein appears in three states: strong, weak and rudimentary.

In another rare instance (Fig. 4), the sectoral radicle has attained direct nodal fusion with the median radicle (12) and has thus been drawn definitely into the mediosectoral linkage group. If the sectoral radicle faded out of existence or became merged with the arculus, the result would be that shown in Fig. 2.

In conclusion it may be remarked that while these phases are consecutive in form, they are contemporary in incidence, occurring as individual variations.

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The Neutrino Theory of Light

SOME time ago I directed attention[1] to some serious difficulties connected with the neutrino theory of light as developed by Jordan and Kronig, namely, (1) the contradiction with the superposition principle especially in the three-dimensional case, and (2) the impossibility of expressing the Bose amplitudes $b(\nu)$ in terms of Fermi amplitudes $\gamma(\nu)$. This criticism has met with objections[2,3]. It has been pointed out that in Jordan's theory the introduction of neutrino-holes is essential and that operators satisfying the Bose commutation rules *can* be constructed if Dirac's theory of holes is used.

My present purpose is to elucidate some points connected with the operators considered, and to point out that (1) the problem of constructing Bose amplitudes remains unsolved, and (2) new difficulties arise in the theory when the neutrino-holes are introduced.

In a theory working with an indefinite number of particles, the following boundary condition for the wave functional is necessary. *The probability of finding more than N physical particles must tend to zero if $N \to \infty$.* The boundary conditions in the ordinary theory (physical particles are neutrinos) are thus different from those in the theory of holes (physical particles are neutrino-holes and neutrinos with positive energy). In the ordinary theory, if we put

$$L(\nu) = \int_{-\infty}^{+\infty} \gamma^{+}(\alpha)\,\gamma(\nu + \alpha)\,d\alpha, \qquad (1)$$

we obtain [1]

$$L(\nu)\,L^{+}(\mu) - L^{+}(\mu)\,L(\nu) = 0. \qquad (2)$$

In the hole theory, we must introduce a new quantized wave function, $\varphi(\alpha,\varepsilon)$, with $\alpha \geqslant 0$, $\varepsilon = \pm 1$, by means of the equations

$$\varphi(\alpha, 1) = \gamma(\alpha)\,;\ \varphi(\alpha, -1) = \gamma^{+}(-\alpha)\,;\ (\alpha \geqslant 0). \qquad (3)$$

The operator (1) transforms[4] into

$$K(\nu) = \sum_{\varepsilon} \int_{0}^{\infty} \varphi^{+}(\alpha,\varepsilon)\,\varepsilon\,\varphi(\alpha + \nu, \varepsilon)\,d\alpha \; +$$

$$+ \int_{0}^{\nu} \varphi(\nu - \alpha, -1)\;\varphi(\alpha, 1)\,d\alpha \quad (\nu \geqslant 0), \qquad (4)$$

and satisfies the Jordan-Kronig commutation rules

$$K(\nu)\,K^{+}(\mu) - K^{+}(\mu)\,K(\nu) = \mu\,\delta(\mu - \nu). \qquad (5)$$

Jordan and Kronig put $\sqrt{\nu}\,b(\nu) = K(\nu)$. But the Bose amplitudes $b(\nu)$ are defined by their commutation rules only if $b(\nu)$ and $b^{+}(\nu)$ form a *complete set of operators*, in the sense that any operator commuting with them must be a c-number. This can only be the case if the parameter ν in $b(\nu)$ includes all the degrees of freedom contained in the arguments of the quantized wave function φ and of the corresponding wave functionals.

This is *not* the case in Jordan's theory, since $\varphi(\nu, \varepsilon)$ contains, besides ν, a new degree of freedom ε, corresponding to a replacement of a neutrino by an antineutrino.

From this it follows that: (1) in Jordan's theory the operators $b(\nu)$ do not form a complete set and are not uniquely determined (we might take for example $\sqrt{\nu}\,b(\nu) = K(\nu) - K(0)$ as well); and (2) all the probabilities and mean values referring to light quanta depend essentially on the values taken by the ε variable.

But a neutrino cannot be distinguished by any physical means from an antineutrino, since according to the very neutrino theory their charge, their mass and their spin are the same and they possess no other physical characteristics. Thus the dependence of the above probabilities on the circumstance whether a particle is a neutrino ($\varepsilon = +1$) or an antineutrino ($\varepsilon = -1$) constitutes a very serious objection to the neutrino theory. If one remembers that the superposition principle is also violated in this theory and that only neutrinos having strictly parallel momentum —the probability of which is zero—are supposed to contribute to the formation of a light quantum, it is difficult to avoid the conclusion that a consistent neutrino theory of light is impossible.

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Leningrad.

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[1] Fock, V., *O.R. (Doklady). Acad. Sci. U.R.S.S.*, **4 (13)**, No. 5 (109), 229 (1936); NATURE, **138**, 1011 (1936).

[2] Stueckelberg, E., NATURE, **139**, 198 (1937).

[3] Nath, Nagendra, NATURE, **139**, 331 (1937).

[4] cf. Sokolow, A., NATURE, **139**, 1071 (1937), where a similar formula is given.

Number of Fragments of the Pułtusk Meteorite

IT is generally stated that the remarkable meteorite fall near Pułtusk, Poland, on January 30, 1868, consisted of 100,000 stones. Thus Charles P. Olivier in his monograph "Meteors"[1] states that "the famous fall at Pułtusk . . . consisted of perhaps 100,000 fragments". Also F. Heide cites in his book[2] the same number, and places this fall as the highest with regard to number of fragments (in the second place comes the shower at Holbrook, Arizona, on July 19, 1912, with 14,000 fragments). The same number is quoted by various works on astronomy and cosmography.

In 1936 I visited the Mineral Department of the British Museum (Natural History) in London, which contains a beautiful collection of fifty-nine Pułtusk meteorites; and in the note placed on the collection I found again the total number "estimated at 100,000". The same value is given also in the guide to the collection of meteorites by Dr. G. T. Prior[3].

In spite of this remarkable agreement of data, the high number of 100,000 fragments does not seem to correspond with the facts. Indeed, in the original report on the Pułtusk meteorite, published in 1868 by the University of Warsaw[4], we find that only 400 fragments had been collected, although the total number of stones which reached the ground at the time was greater. On the other hand, the Polish "Cosmography" by J. Jędrzejewicz[5] estimates the amount of the Pułtusk shower at about 1,000 stones, and the Polish edition of the "History of the Earth" by M. Neumayr[6] at 3,000 stones.

What is the source of this discrepancy? The original paper of 1868 contains the figure 100,000; this, however, does not refer to the number of fragments of the shower, but only to the result of chemical analysis, which is as follows:

Silicates soluble in HCl	47·014
Silicates insoluble	52·986
	100·000

Therefore it seems to be probable that this total (100 per cent) was erroneously read by someone as hundred thousand and cited as the number of meteoric fragments.

This explanation would account for the enormous figure quoted for the number of fragments stated to have fallen on January 30, 1868, near Pułtusk. As to the real number, I believe that 3,000 stones, as given by Neumayr, may be adopted as the most probable number of fragments.

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[1] "Meteors" (Baltimore, 1925).

[2] "Kleine Meteoritenkunde" (Berlin, 1934).

[3] "Guide to the Collection of Meteorites" (Brit. Mus. (Nat. Hist.), 1926).

[4] "Notice sur la météorite tombée le 30 Janvier 1868 aux environs de la ville de Pułtusk" (Haute École de Varsovie).

[5] "Kosmografja", 2nd edition, by M. Ernst (Warsaw, 1907).

[6] "Dzieje Ziemi", vol. 1 (Warsaw, 1912).

Points from Foregoing Letters

FROM measurements of the energy of an electron-positron pair, produced by a beta particle of energy 1·1 MV. in a mixture of nitrogen and mercury dimethyl vapour (5 per cent), Dr. F. C. Champion and A. Barber find that there is approximate agreement with the values obtained by Skobelzyn and Stepanowa when beta particles impinged on lead. It appears that the probability of pair production by beta particles of low energy increases rapidly with the atomic number and is large when the energy of the beta particle is of the order $2mc^2$.

The rate of elimination of 0·5–14 millicuries of radon injected into rats is found by Dr. F. Běhounek and F. V. Novák to be half an hour when glucose solution is used as vehicle, and several hours when tungsten emulsion is used as vehicle.

By plotting the logarithm of the rate of diffusion (through rubber) for various gases, against the inverse absolute temperature, R. M. Barrer finds straight line relations. He also gives a table for the energies of activation, calculated from the linear diffusion curves in the case of vulcanized and para rubber, and concludes that only an explanation involving activated diffusion can account for the diffusion increasing approximately with the temperature.

A method for measuring small amounts of gas liberated during certain chemical reactions, using a modified 'Cartesian diver' technique, is described by Dr. K. Linderstrøm-Lang.

D. A. Wright points out that the resistance-temperature curve obtained by Cosslett for thin films of indium indicates a transition temperature at about 10° C., in agreement with Kramer's formula. Thin films of rubidium and cæsium, on the other hand, do not behave in accordance with deductions based on Kramer's theory.

The differential cross-section for transition of a Dirac electron between two states of positive energy in a Coulomb field has been calculated by J. C. Jaeger for lead in the case of an incident electron of total energy $3mc^2$ losing energy equivalent to 1·5 and $1{\cdot}95mc^2$. The theoretical values obtained by Jaeger agree fairly well with the theoretical values calculated by means of Born's approximation except near the short wave limit.

Prof. D. M. Bose reports measurements of the absorption spectra of crystals of neodymium chloride ($NdCl_3.6H_2O$), which, he considers, illustrate the six oxygen atoms grouped octahedrally around a (paramagnetic) neodymium ion. Dr. W. G. Penney and G. J. Kynch point out that the agreement claimed by Spedding and others, between the spacings of the low-lying levels of various rare earth ions, as deduced from absorption spectra measurements and from theoretical considerations of the temperature variation of the magnetic susceptibilities, is probably fortuitous. The magnetic data is not sufficiently detailed to permit accurate determinations of the levels.

A spectrum band in the region 3600–3700 A. observed when running a high-tension arc between chromium electrodes in a flame of hydrogen burning in air, is attributed by A. G. Gaydon and Dr. R. W. B. Pearse to chromium hydride.

From the intensity of the components in the hyperfine structure of the lines 3944, 3961 and 3093 A. (observed by absorption) and 6696 and 6699 A. (observed in emission), D. A. Jackson and Dr. H. Kuhn calculate for aluminium a nuclear spin of 9/2, which does not agree with the previous value of ½, suggested by Ritschl. The magnetic moment, calculated from Goudsmit's formula, is approximately 4 nuclear magnetons.

The results of investigations on the relation between dilution of virus preparations and number of infections caused suggest, according to J. G. Bald and G. E. Briggs, that in the tobacco mosaic group there is an end-to-end aggregation of the virus particles comparable with the 'crystal' structure recently described.

Fruit flies (*Drosophila melanogaster*) treated with fast neutrons from a radium-beryllium source, show, according to Mary Nagai and G. L. Locher, a larger proportion of mutations than untreated flies, as indicated by the sex-linked lethals, which increased 2½ times.

Certain deviations from the ordinary compound interest law of frond increase which have been established for *Lemna minor* grown under constant conditions are described by H. Dickson. These involve a secular variation which takes the form of a wave with a 25–35 day cycle, and superimposed on this a short periodic cycle of 4–6 days. Successive measurements of dry weight also show a secular wave. It is suggested that a social biological effect may be responsible for these growth cycles.

Research Items

Natives of Mount Hagen, Papua

Mr. F. E. Williams, Government anthropologist, Papua, in *Man* of June, records some results of a short visit by aeroplane to the natives of Mount Hagen, the previously unknown tribes first described by Mr. E. W. P. Chinnery in 1934. Information going beyond externals was obtained from Fr. Ross of the Mission of the Society of the Divine Word, who has now resided among them for two years. He estimates that there are now 25,000 natives speaking various dialects of the Mount Hagen language, divided into some twenty tribes, who are again divided into numerous local groups. One of the most remarkable features of the life of these peoples, as well as of the Papuans recently patrolled by Hides and O'Malley, is that they have no villages, but live in scattered homesteads, to some extent grouped together as settlements, something like primitive garden cities. Descent is patrilineal, and marriage patrilocal. Girls marry young, and there is a ceremonial payment. Many households are polygamous. The natives are of strong build and fleshy with somewhat heavy, decided features and a darkish skin. The men mostly wear fine black beards, and the women roll their eyes. Altogether they are a good-looking people, of a caste that is Papuan rather than Melanesian. The main item of dress of the men is an apron of fine netting, black, greasy and soft, which is suspended from the belt, and reaches below the knees. Behind they wear numerous twigs of *Dracæna* tucked into the belt. The belt is of stiff bark, up to eight inches and more in width. It is usually plain, but sometimes is decorated with incised geometrical patterns. Thongs of stiff cane may be bound round the belt near the upper and lower margins. To some extent, the belt may have served the purpose of armour. The hair is worn short by boys and youths, but nearly all adults cultivate a fairly long growth, which is tightly encased in bark cloth, bound round the forehead and occiput with a band of the same material. This gives the effect of a well-stuffed globular cushion.

Serbian Gypsy Feast-Days

Dr. Alexander Petrovič continues his studies of Serbian gypsies with an account of the feast days they observe (*J. Gypsy Lore Soc.*, Ser. 3, **16**, Pt. 3). While the Serbs belong to three religions, Orthodox, Catholic and Mohammedan, the Gypsies are Orthodox and Mohammedan only. As, however, the only mosque is at Nish, the Gypsies of other localities perform for themselves the rites of baptism, marriage and burial. In Bosnia, the Mohammedan clergy hold that the Gypsies were never true Mohammedans. On the other hand, neither are the Orthodox priests pleased with their Gypsy parishioners; but scarcely more satisfactory in his home was the Serbian peasant of the illiterate class up to the beginning of the present century, for he preserved his ancient pre-Christian customs and beliefs. While the Serbs could not carry out a feast without the services of the Gypsies in some capacity or other, the Gypsies, though thus made familiar with them, on conversion adopted only some of the beliefs and customs of their Orthodox fellow villagers. They considered the feast of Bibi as their greatest religious holy day. Bibi is a disease—cholera. In order to protect their children from being strangled by Bibi, they founded the cult, and propitiate her by celebrating her feast day. She then protects their children from her wrath. This basic idea of a strangler going from house to house is borrowed from the Serbs, who think that the cause of every illness is some living thing that enters a man. Plague and cholera are women dressed entirely in black, who always carry an infant in their arms. It is evident that the Gypsies are beginning to forget the origin of their belief in Bibi. She is for them a Gypsy woman who has babies and likes Gypsies, protecting their children, while she strangles those of the Serbs. Many Gypsies believe that Bibi has appeared to them in their dreams, and this is to them the strongest proof that Bibi really exists. Until some years ago, Bibi's day was celebrated only by a few colonies between Belgrade and Krusevač. Now it is becoming widespread, though confined to Orthodox Gypsies speaking Romani.

Embryonic Monkeys and Man

No complete account of the intra-uterine development of any species of monkey appears to have been published, and therefore the description of the prenatal development of the grey langur, *Semnopithecus priam thersites*, by Prof. W. C. Osman Hill, is of unusual interest (*Spolia Zeylanica*, **20**, Pt. 2, 211; 1937). The embryos differ from human embryos very early in showing, as a rule, a double placenta instead of a single one, in possessing 43 instead of 38 body somites, a more slender body form, a longer tail, which persists and grows after the tenth week, and slightly different feet and hands, in which the thumb is rudimentary at the 24·5 mm. stage. On the other hand, resemblances between the development of the monkey and corresponding human stages are shown in the peculiar twist on the long axis of the 9 mm. embryo, the form of the neural tube and cerebral vesicles, the mode of formation of the face and branchial arches, the slight advance in development of fore limb over hind limb, the presence of an umbilical hernia, the disproportionately large head, and large cranium relative to face, the projection of the upper jaw beyond the lower in about one third term embryos, and the presence of a lobule on the pinna. The last character seems to be confined to the family of monkeys to which the genus belongs and to man, for it is not found in the apes, nor in macaques or their relatives. It has, in fact, usually been regarded as a peculiarly human characteristic.

Effect of Pasteurization on the Nutritive Qualities of Milk

The annual report for 1936 of the National Institute for Research in Dairying, University of Reading, recently issued, contains summaries of two researches carried out at the Institute upon the effect of pasteurization upon the nutritive qualities of milk. In one experiment, shorthorn bull calves when 4–5 days old were grouped in pairs of similar age and weight, and one of each pair, chosen by lot, received raw, and the other pasteurized, milk until the completion of the experiment twenty-six weeks later. The milk diet was supplemented from the ninth week onwards with a little hay, and from the seventeenth week with a small allowance of crushed oats and flaked maize. Records were kept of the food consumed, the live weight gains, general appearance of the animals and other relevant matters. Eleven pairs completed the experiment, and no material difference could be detected between the two groups. The average daily live-weight gain per head for the calves receiving raw milk were 1·967 lb., for those receiving pasteurized milk 1·969 lb. Another study was on the effect of commercial pasteurization upon the nutritive value of milk. The raw and pasteurized milks were from the same bulk, the experiments being carried out on rats. No marked loss in the value of milk as food which could be attributed to commercial pasteurization could be detected. One fifth of the vitamin C content of raw milk is lost in the course of commercial pasteurization, but this is partly due to exposure to light. Milk exposed in a bottle in the sun for half an hour loses half its original antiscorbutic properties.

Fossil Insects from Kansas Rocks

Contribution No. 16, on Kansas Permian insects, by the late Dr. R. J. Tillyard, appeared in the December issue of the *American Journal of Science* (**32**, 435–453; 1936). In addition to describing new fossil mayflies, the author discusses the affinities of his group Protohymenoptera. The eminent Russian worker on fossil insects, A. Martynov, and also F. M. Carpenter, of Harvard University, claim that this group is not a separate order apparently ancestral to the Hymenoptera but a subdivision of the fossil order Megasecoptera. Carpenter claimed that Tillyard had misinterpreted the venation, and concluded that any affinities with the Hymenoptera were extremely remote. Tillyard re-examined the subject in this paper and accepted Carpenter's revision of the venation, but reaffirmed his opinion that the Protohymenoptera are ancestral to the Hymenoptera. The fact that a large and complete ovipositor is present in *Asthenohymen*, it is claimed, strengthens this argument. This character, furthermore, argues against Carpenter's contention that the Protohymenoptera are specialized members of the Megasecoptera since none of the latter possessed an ovipositor. The presence of three-segmented tarsi seems to preclude Tillyard's Protohymenoptera being on the direct line of descent of the Hymenoptera, which have five-segmented tarsi. Tillyard argued that since *Asthenohymen* is the most advanced member of the Protohymenoptera, more archaic forms may have possessed tarsi of five segments.

Scottish Copepods

Dr. S. G. Gibbons, who has already studied certain copepods of Scottish seas in some detail, now reports on collections made by the R.R.S. *Explorer* in February–November 1933 on eight cruises covering a large area and including the southern North Sea, the Hebrides and Faroes and round to the Moray Firth ("*Calanus finmarchicus* and other Copepods in Scottish Waters in 1933". Fishery Board for Scotland. Scientific Investigations 1936, No. II). Except for two large isolated patches at the surface in May and June, the bulk of the *Calanus* population (later copepodid and adult stages only being considered) were taken in the mid-water and bottom nets and few were in the surface layer. From February until July they were mostly in mid-water; from August onwards they were in the deepest layer. This indicates a general sinking towards the end of the year. There is conspicuous vertical movement, and the figures show a maximum diurnal migration which takes place at those seasons when the hours of darkness are longest, whilst in July when the light is strong the difference is less marked. As in previous years, *Calanus* proved the dominant plankton organism throughout the year, their greatest abundance occurring in June in the Faroe Shetland Channel region, and the least in the North Sea in November. Among the other copepods mentioned is *Anomalocera pattersoni*, the 'blue feed', well known as important herring food, which occurs in numbers in certain areas in May and June. It is noteworthy that, in the chart showing its abundance together with *Calanus*, it should be usually more abundant than that species when it occurs. Although nothing is said to this effect, it is probably because *Anomalocera* is eating *Calanus*, for it is a voracious copepod feeder.

Feeding Habits in Pleuronectidæ

The relationship between the structure of the brain and the feeding habits of the Pleuronectidæ has been studied by H. Muir Evans (*Proc. Roy. Soc.*, B, May 1937). The same author has previously shown a relationship between the structure of the medulla oblongata and the feeding habits in cyprinoids, clupeoids and gadoids. In the present work, the investigation is extended to include the fore-brain, mid-brain and infundibulum. Four groups can be recognized: (1) typified by the sole, a purely bottom, night feeder; (2) typified by the plaice, which is also a bottom feeder but utilizes sight, taste and smell; (3) typified by the turbot, which is predatory and feeds by sight; and (4) typified by the halibut, also predatory and feeding by sight. The fourth group is distinguished from the third by the deep dorso-ventral extension of the olfactory lobes and by a different arrangement of the tubules of the pituitary gland.

A Disease of Hawthorn

A short paper by Messrs. W. J. Dowson and W. A. R. Dillon Weston (*Gard. Chron.*, 426, June 19, 1937) directs the attention of plant pathologists to a brown rot of the hawthorn. The malady, which is fairly widely distributed in East Anglia, is caused by the fungus *Sclerotinia cratægi*. The conidial stage only has yet been found in Great Britain, but the ascigerous condition has been known for many years in Germany and the United States. Similar diseases appear on the medlar and quince, but are caused by different species of *Sclerotinia* from that which attacks the hawthorn. Symptoms are a browning of the young shoots, the dead leaves of which often bear a sweetly-scented powdery grey mould of conidia. The disease may be more widespread than is reported by the present paper, and appears to be sufficiently destructive to mar the beauty of a quick-thorn hedge.

Gold Deposits of the Canadian Shield

A review of the geological relations of some of the chief gold deposits of the Canadian Shield is presented by E. L. Bruce in a paper read at the New York Meeting of the American Institute of Mining and Metallurgical Engineers (*Technical Publication* No. 807; 1937). Summaries are given of the Beattie and Sisco mines of Quebec, of the mines of the Porcupine and Kirkland Lake area, and of the Howey and other mines of north-west Ontario. It is shown that there are few places in which a genetic relationship between ore-bearing solutions and neighbouring igneous rocks can be satisfactorily established. In some places where such relationships have been assumed, later investigation has shown that the igneous rocks are very much older. In deposits like those of Porcupine and Kirkland Lake, it seems likely that the solutions that formed the veins were derived from a magma far below the present surface and that the veins are localized by structural factors. The fact that contacts between igneous rocks and the rocks invaded are structurally favourable for the development of zones of fracturing, in some deposits at least, explains the occurrence of gold-bearing veins near intrusive bodies.

Formation of Submarine Canyons

IN recent years, there has been much discussion of the various hypotheses suggested to explain the formation of submarine canyons and gorges. The only hypothesis to which there are no serious objections is that proposed by Daly. During the low sea-levels of the Pleistocene glaciations, mud was stirred up by wave action on the shallowing continental shelves. In this way, a suspension was formed with a higher specific gravity than that of clear seawater. The 'heavy' liquid flowed down the continental slope, as submarine currents which developed ruts in the soft bottom deposits and gradually deepened them into gorges. This theory, though superficially seeming to be improbable, has been greatly strengthened by experiments carried out at Leyden by Ph. H. Kuenen (*Leidsche Geol. Med.*, (2), **8**, 327–351; 1937). The results prove that a suspension will flow down a slope without being much diluted by mixing with the adjacent clear water, and that such a flow will concentrate in slight depressions in the surface. Quantitative data and comparison with natural slopes show that the velocity of the actual submarine currents should be somewhat lower than that of large rivers, but increasing as it proceeds and picks up more sediment. At the lower end the suspension gains six times the effective density with which it began and two or three times the velocity, and at this stage the load of sediment being carried is that of the most muddy major rivers. Though the data are rough, they show that no preposterous assumptions are involved in accounting for such submarine canyons as those of the Georges Bank. It is of special interest to note that an 8 mm. film of about 20 metres length, illustrating the experiments, can be obtained at the price of 8 guilders from the Rijksmuseum van Geologie at Leyden.

A New Type of Threaded Connexion for Oil Well Casing

AT a meeting of the Institution of Petroleum Technologists on May 4, Mr. W. M. Frame described a new type of threaded connexion for use on oil well casing. Casing having such connexions is known as 'extreme line casing' and is being used successfully in a number of the United States oil fields. The joint consists simply of an upset, threaded pin end and an upset, threaded box end without any coupling. A shoulder is provided on the pin end to avoid any abrupt change of contour, and the outer surface is turned and the inner bored to give more accurate joint dimensions than are normally obtainable. The advantages claimed for this type of joint over the normal V-threaded type are that it is stronger and has a higher resistance to leakage and accidental drainage, that the external joint diameter is smaller and has a stream-lined contour both inside and out. Experience has shown that a great saving of time in running and pulling can be effected with this 'extreme line casing' as compared with collared casing.

A West Indian Hurricane

AN account was given by Mr. C. S. Durst, at the meeting of the Royal Meteorological Society on May 26, of a case that occurred in September 1936 of a West Indian hurricane which recurved into middle latitudes towards the far side of the Atlantic and crossed over almost to the Irish coast without losing its tropical character of a mass of revolving tropical air. The recurve took place at about lat. 30° N., long. 61° W., and the track of the storm was then an almost straight one to the south-west of Ireland. As the storm approached the polar front, which lay at about lat. 45° N., a new depression developed on that front and became intense, and to this development is attributed a great increase in the speed of travel of the tropical storm. When centred at about lat. 43° N. and long. 39° W., its continued tropical character was well shown by the existence of a northerly wind of nearly gale force of which the temperature was 74° a short distance behind the centre. The author was unable to find any previous case of this kind of a persistent revolving tropical vortex within the warm sector of another depression farther to the north. He attributed the abnormal features in this case to the fact that the encounter between the tropical storm and the polar front took place in mid-ocean, and to the fact that a very shallow disturbance already existed on the polar front at that point. It is more usual for tropical storms to reach the coast of America and to have greatly diminished in intensity by the time that they encounter the polar front, and for their tropical characteristics to be lost in the temperate depression which results.

Passivity of Iron

EXPERIMENTS by W. H. Cone and H. V. Tartar (*J. Amer. Chem. Soc.*, **59**, 937; 1937) show that iron is passive in solutions of chromic acid at all concentrations. If the solution also contains sulphuric acid or other activating electrolytes such as phosphoric acid and sodium sulphate, the iron under reduced pressure becomes active, but in pure chromic acid solutions iron does not become activated by reduction of pressure. An atmosphere of hydrogen causes iron to be active in a chromic acid-electrolyte solution. Oxides of iron were found to be soluble in chromic acid solutions, and oxide-covered wires could be made active by a reduction of pressure. This makes it doubtful whether an oxide layer is an essential factor for passivation, as has been asserted, and an adsorbed film of oxygen or a "two dimensional compound" of iron and oxygen as the primary cause of passivity is suggested. Definite oxides may be formed afterwards, particularly in the case of anodic passivation, but such oxides are readily soluble in the acidic solutions used by the authors.

Transmission of Excitation in Living Material

On Thursday, June 3, at the Royal Society, Dr. C. F. A. Pantin opened a discussion organized by Prof. A. V. Hill on "The Transmission of Excitation in Living Material", which was largely devoted to the consideration of the rival merits of electrical and chemical theories of conduction.

The electrical theory, which has been worked out mainly in connexion with the nerves of vertebrates, is briefly as follows. We know that conducting tissues may be excited at the cathode by an applied electric current, and we also know that the propagated wave is invariably associated with an electric disturbance which is in such a sense that the current flowing between the active and the inactive regions of the tissue has the cathode on the inactive part, and is hence in the direction which tends to excite it. Thus it is clear that if the disturbance is intense enough, the inactive region in front of the wave must be raised to activity, thereby achieving propagation. Whether in fact this is the mechanism therefore rests upon the measurement of the adequacy of the electrical disturbance to excite the region in front of the wave.

This study was presented by A. L. Hodgkin (Cambridge), working on frog's nerve in which the propagation was blocked by the application of pressure or by freezing. Though the impulse is not able to traverse the block, yet the electrical current spreads out into the inactive region and produces there a considerable exciting effect, for, when the shock setting up the impulse is followed by a second shock applied this time to the inactive region just beyond the block, and so timed that it coincides with the electrical disturbance due to the blocked impulse, it is found that the second shock can be effective at only 10 per cent of the intensity necessary when applied alone. The excitability thus measured is found to follow a time course nearly identical with that of the electrical wave from the blocked impulse. It is clear that if at some distance from the disturbance the excitability is raised to 90 per cent threshold, at the active region itself the current will be fully adequate. Thus the electrical theory is established for conduction in frog's nerve.

But the adequacy thus shown for a full-grown impulse will not apply to the very small impulse arising from the area under the cathode of an external stimulating circuit. It is clear that a stimulus, to be effective, must not only excite the tissue at a point, but also must nurse the new-born impulse until it has reached a size adequate to propagate on its own.

The results of a mathematical development of this aspect were presented by W. A. H. Rushton (Cambridge), who pointed out that, in spite of shortcomings due to over-simplification, it is possible to describe quantitatively the whole range of excitability measurements both spacial and temporal, including some observations hitherto unexplained, with only two arbitrary constants.

Now in the intact organism, nerve-muscle activity is carried out by impulses following each other in rapid succession, hence the electrical generation of repetitive impulses from continuous currents is of interest. A. Monnier (Paris) has found that excised nerves and muscles in solutions of low calcium ion content respond to prolonged continuous currents with prolonged rhythmic discharges. The bearing of this upon the mode of origin of central nervous rhythms was strongly indicated by B. H. C. Matthews (Cambridge) from oscillograph records of single motoneurones. When these cells are provoked to reflex activity by sensory stimulation, in addition to the quick potential change associated with each impulse there are slowly developed changes localized somewhere in the spinal cord, apparently produced by the cumulative effect of the sensory impulses, and acting like the prolonged currents in Monnier's experiments. This similarity has been further confirmed by passing a prolonged current in at the nerve and out at the cord, which, even in the absence of sensory stimulation, produced repetitive impulses of reflex character.

Though these experiments suggest that electrical considerations are sufficient to explain the passage of an impulse from one cell to another, there is quite other evidence, primarily pharmacological, which shows that the liberation of a specific chemical substance in relation to the cell junction may be of great importance.

Adrenalin has long been known to produce, when injected, the same general effects as widespread sympathetic stimulation, and it is now recognized that sympathetic nerves act by liberating adrenalin (or something very like it) in intimate relation to the cells of the organ supplied. Later, a similar state of affairs was found in connexion with the parasympathetic nerve endings, but the specific chemical, acetyl-choline is rapidly inactivated by an enzyme normally present and hence cannot be obtained unless the enzyme is inhibited by eserine. Chemical transmission was thus established in conduction between cells in two important classes, and the question arose as to whether some chemical was invariably necessary for such conduction. In particular, the cases of nerve-voluntary muscle, sympathetic ganglion and central nervous system are receiving consideration, but the possibility of a similar chemical counterpart of transmission down the nerve fibre itself is not overlooked.

A. von Muralt (Bern), realizing that any liberation of acetyl-choline during nerve transmission must be almost instantaneously reversible, adopted the following method to 'fix' the chemical liberated by a single impulse. The stimulated nerve together with an unstimulated control were shot instantaneously into liquid air, withdrawn, and ground to powder in solid carbon dioxide and then extracted and tested pharmacologically for acetyl-choline. It was found that the stimulated nerve contained about twice as much as did the control, but as was brought out in discussion with Prof. J. H. Gaddum, this was possibly due to the effect of the applied current (as in Gaddum's own experiments) for the results were more pronounced with prolonged currents, and the 'resting' control was probably excited by contact with the liquid air.

G. L. Brown (Hampstead), continuing the work of Dale and his other colleagues, showed that when an impulse passes from nerve to muscle, not only is acetyl-choline liberated in circumstances strictly limited to the passage of the impulse, but also that the injection of it suddenly into an artery in close relation to the muscle gives rise to a twitch very similar both from mechanical and from electrical records to that produced on nerve stimulation.

F. Buchtal (Copenhagen) has made a more minute study of the structures involved in this transmission. Working with single muscle fibres from the lizard, he measured the resting and active potentials on the surface of the muscle and the nerve-muscle junction. There is a resting potential of some 50 mV. between junction and fibre, and this difference is reversibly reduced to zero by the drug curare, which simultaneously produces a reversible nerve-muscle paralysis.

Z. N. Bacq (Liège) treated from a much wider zoological aspect the question of chemical transmission, and showed that, though acetyl-choline may be regarded as transmitter over a great range, yet this substance is not present in the Protochordates, the Crustacea, or the Cœlenterates.

J. C. Eccles (Oxford) considered the application to ganglion and central nervous system. He presented evidence for two transmitters, one rapid, and apparently related to the electrical effect, the second slower and probably related to acetyl-choline.

This same duality was advocated by C. F. A. Pantin (Cambridge) in his opening communication. His own work on sea anemones and crabs shows that facilitation at the nerve-muscle junction depends upon both the number and the frequency of impulses arriving there. A chemical transmitter is suggested because the time relations of the decay of facilitation are much longer than those of electrical effects, and are not dependent upon ions as are the electrical phenomena. On the other hand, the accumulation of facilitating chemical is never sufficient to set up repetitive impulses on its own account, nor are the ionic changes which increase facilitation capable of allowing a first impulse to pass; it seems that in these systems it is necessary to have the electrical change associated with the present impulse as well as the chemical facilitation resulting from a previous impulse. He also pointed out that the study of comparative physiology is rich in examples of the same end being achieved by different means, and of the same means being employed to different ends, or to no end at all. The fact that a certain chemical has important function in one tissue and that it is also present in another tissue, cannot be used as indicating that it has any biological significance in the second case.

Prof. E. D. Adrian, starting the open discussion, was also of the opinion that both electrical and chemical conditions are involved in transmission. He pointed out, however, that the secretion of molecules so strongly polar as those of acetyl-choline may involve quite considerable potential changes, while on the other hand the diffusibility of acetyl-choline through lipoids makes this ion of importance in the passage of electricity through cell walls. It is therefore possible that some of the phenomena variously considered as electrical or chemical may in fact be merely two aspects of the same process.

W. A. H. RUSHTON.

The Individuality of Gliadin

By Prof. A. G. Kuhlmann, Research Institute of the Baking Industry, Moscow

THE principal proteins of wheat are, as is well known, glutenin and gliadin. These proteins, upon the interaction of wheat flour with water, form the so-called gluten, the quality and quantity of which is of such great significance in the baking of bread, in the manufacture of macaroni, noodles and similar products. In the numerous works devoted to the proteins of wheat, a great deal of attention is paid to the question of the individuality of glutenin and gliadin.

Considering gluten to be a natural high polymer, we must come to the conclusion that it represents a complex of proteins, forming micelles of various length. Such a conclusion has been fully confirmed by an investigation which I conducted in my laboratory, which showed as well that the longest and most stable micelles are those of glutenin. Gliadin consists of shorter micelles, which are less stably built and more flocculent than those of glutenin.

According to the literature, the gliadin of wheat is best extracted by a 70 per cent solution of ethyl alcohol. A study of the influence of the concentration of ethyl alcohol on the peptization of the proteins of gluten carried out in my laboratory gave the following picture (Fig. 1). In one series of experiments, samples of one and the same gluten were treated with alcohol-water solutions. The experiments were repeated, this time a given sample of gluten being treated with alcohol solutions of increasing concentration (alcohol of higher concentration being used only after complete extraction with alcohol of the preceding lower concentration).

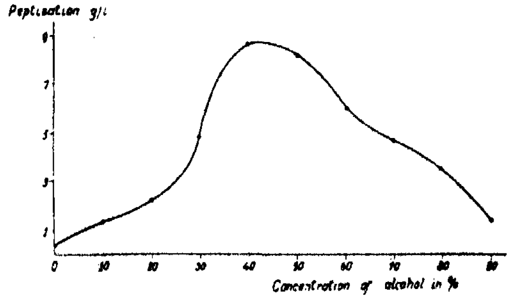


Fig. 1.

Results of these experiments are shown in Fig. 2. The data of both these series of experiments are in good agreement with each other and show that maximum peptization occurs with alcohol having a concentration of about 40 per cent. The investigation of several kinds of gluten gave an analogous picture.

When gluten is treated with alcohol of low concentration (up to 30 per cent C_2H_5OH) it retains its cohesive properties and changes only slightly in its external appearance. Upon treatment with 40 per cent alcohol, it is greatly altered ; it loses its cohesive properties and begins to disintegrate into separate particles. The supernatant liquid becomes turbid and viscous.

It is a striking fact that peptization of gluten by alcohol of various concentrations falls considerably more sharply after reaching a definite maximum, in the case illustrated by Fig. 2 than that by Fig. 1. This can be accounted for by the presence in gluten of a less highly aggregated and more easily peptizable fraction the solubility of which reaches a maximum with concentrations of alcohol of about 40 per cent. This fraction, through interaction with the more highly aggregated and less soluble fraction of gluten by means of absorption, acts as a peptizer of the latter. It also conditions the stability of the sol obtained. This fraction, when separate samples of gluten are extracted by different concentrations of alcohol (Fig. 1), asserts its action even at high concentrations ; while when one and the same sample is extracted by alcohol of different concentrations, the alcohol solutions containing more than 40 per cent C_2H_5OH, devoid of this less highly aggregated fraction of gluten due to its solution by the alcohol solutions of lesser concentrations, show a sharp decrease in peptizing properties (Fig. 2).

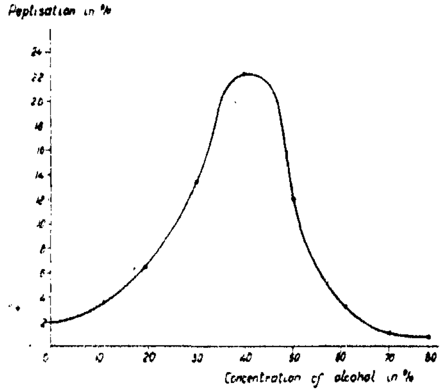
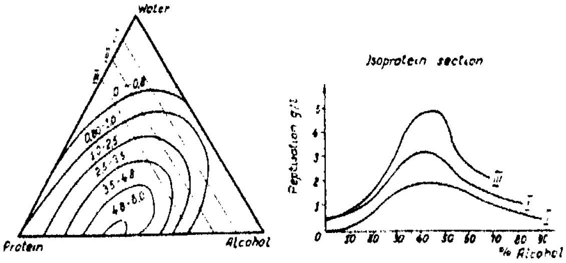


Fig. 2.

A study of the peptization of the proteins of gluten as a tricomponent system, sol of gluten – alcohol – water, using the method of the triangular diagram of Gibbs, was also carried out in my laboratory on twelve specimens of wheat. In general, they all gave analogous results. A typical example is shown in Fig. 3 (*a*). Isopeptides (lines connecting the points of equal quantities of peptized colloids) clearly show a definite maximum of peptization at a definite concentration of alcohol (40–50 per cent). If isoprotein sections (lines I, II, III) parallel to the side *BC* and connecting points of equal quantities of protein are drawn, then the above-mentioned maximum is seen still more clearly (Fig. 3 (*b*)).

If proteins are extracted with 40 and 70 per cent alcohol-water solutions from separate samples of a given specimen of gluten, then we obtain two products, different from each other with respect to their behaviour towards water (swelling and hydration). Thus the protein fraction extracted with 40 per cent alcohol from the gluten of the wheat Lutescens 0329 imbibes 1·63 gm. of water (calculated on the basis of 1 gm. of dry substance), while gliadin (that is, the fraction extracted from that same sample of gluten with 70 per cent alcohol) imbibes 1·83 gm. The corresponding fractions extracted from the gluten of the wheat Ferrugineum *H* 622 gave a still more distinct picture : here gliadin imbibed 1·08 gm. of water while the '40 per cent-fraction' imbibed 0·91 gm. The gliadin of that wheat increased its volume by 158 per cent on swelling, while the '40 per cent-fraction' increased by 135 per cent.



(*a*) (*b*)

Fig. 3.

The above data, as well as other observations noted in my laboratory, give me reason to maintain that the gliadin of wheat is not a chemical individual. It represents an adsorption complex of at least two fractions, which I name α- and β-gliadin. In its properties (swelling, peptization, etc.) β-gliadin approaches glutenin. β-gliadin dissolves as a result of interaction by means of adsorption with the more easily peptizable fraction, α-gliadin, which forms the main mass of Osborne's gliadin.

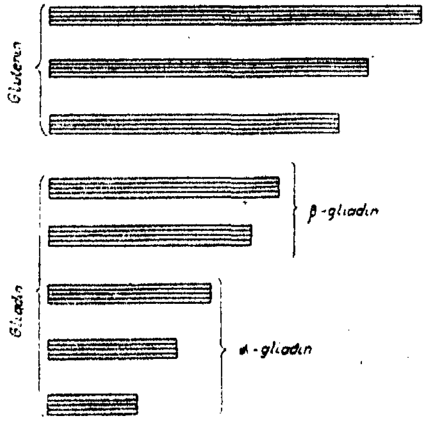


Fig. 4.

In the light of this work, the distribution of proteins of the various fractions of gluten according to the length of their micelles may be represented schematically as in Fig. 4.

Research in this field is being continued.

Intellectual Co-operation and International Science

A JOINT meeting of the Executive Committee of the International Council of Scientific Unions and of the Scientific Experts Committee of the International Organization of Intellectual Co-operation was held on July 9–10, at the International Institute of Intellectual Co-operation, in Paris.

Representing the Executive Committee of the Council were: Prof. C. Fabry, chairman of the Council; Prof. H. R. Kruyt, vice-president; Prof. D. B. Němec; Prof. F. J. M. Stratton, general secretary of the Council; E. Esclangon, representing the International Union of Astronomy; Jean Gérard, representing the International Union of Chemistry; General Perrier and Brigadier H. St. J. L. Winterbotham, representing the International Union of Geodesy and Geophysics; General Bourgeois and E. J. Voute, representing the International Union of Geography; Profs. Abraham and A. Cotton, representing the International Union of Physics; and Dr. M. J. Sirks, representing the International Union of Biological Sciences. The Committee of Scientific Experts included: Prof. Cabrera, chairman of the Committee and professor of theoretical physics at the University of Madrid; Prof. Białobrzeski, professor of theoretical physics in the University of Warsaw; Prof. F. A. E. Crew, director of the Institute of Genetics at the University of Edinburgh; Prof. P. Langevin, professor of experimental physics in the Collège de France; Prof. Ch. Maurain, dean of the Faculty of Sciences of the University of Paris; Prof. Harry M. Miller, professor of zoology in Saint Louis University; Prof. M. Plancherel, professor of mathematics in the Polytechnic Federal School of Zurich; Prof. A. A. J. de Sigmond, professor of agricultural chemistry in the Palatin Joseph University of Technical and Economical Sciences, Budapest; and Prof. E. Späth, rector of the University of Vienna.

This meeting is the result of several years negotiations between the International Council of Scientific Unions and the International Organization of Intellectual Co-operation, the outcome of which was the approval by the assemblies of the two organizations of the draft agreement prepared by a joint committee of representatives of the Council of Scientific Unions and of the International Committee on Intellectual Co-operation.

The agreement lays down in detail the manner in which the two institutions are to collaborate. The International Council of Scientific Unions will henceforward act as the advisory body to the Intellectual Co-operation Organization on questions of a scientific character, while the latter will be consulted by the Council on all international matters concerning the organization of scientific work. The executive organs of the Intellectual Co-operation Organization will provide the secretariat for the committees to be appointed by the Council, the president of which will *ex officio* attend plenary meetings of the Committee on Intellectual Co-operation at which the sciences are discussed; a representative of the Intellectual Co-operation Organization will take part in the meetings of the Executive Committee of the Council.

One of the aims of the meeting of July 9–10 was the signing of this agreement by the presidents of the two organizations, Prof. Gilbert Murray and Prof. C. Fabry. It also dealt with a number of other questions, among which are: the analysis of the scientific programme of the Organization of Intellectual Co-operation, that is, co-ordination in the matter of scientific research (financial aid, collaboration with the scientific unions for the preparation of small co-ordinating committees, publication of reports on the progress made in each branch of science); scientific bibliographies (transcription of the titles and the names of authors of scientific works written in a language that does not use Roman characters, and compilation of a bibliography of scientific works published in such languages); 'scientific conversations' the first of which will deal with "the general consequences of deep alterations that have taken place in physics concerning the principles of the explanation of the natural phenomena", etc. . . .

The Committee has also studied the programme and methods of the International Council of Scientific Unions and examined several new proposals received by the Organization of Intellectual Co-operation, among which are the publication of old scientific manuscripts and the question of the co-ordination of work in the study of physical constants.

It is necessary to emphasize the importance of the signing of the agreement by the presidents of the two organizations. It marks the beginning of a practical collaboration removing all possibility of overlapping, and having as a result the development of a definite programme.

New Chemistry Laboratories at Birmingham

THE new A. E. Hills Laboratories, which form a most valuable extension of the Department of Chemistry in the University of Birmingham, were formally opened by the donor (Mr. A. E. Hills) on July 7. The pro-chancellor (Mr. Walter Barrow) expressed the gratitude of the University to Mr. Hills for his generosity in giving £50,000 to build the laboratories, as well as a further gift of £25,000 for postgraduate scholarships. Benefactions by Birmingham donors have provided a further £7,700 for equipment (including £4,200 from Cadbury Bros. and £2,000 from W. Canning and Co.)

The opening address was given by Sir Frederick Gowland Hopkins, who remarked that every encouragement given to chemistry increases the possibility of discoveries of universal value. The thoughts of physicists and that of chemists, which have been separate, are coming nearer together, and the help which chemistry has given to physics in the past is to-day being handsomely repaid; though there is still an inherent distinction between the modes of thought of the chemist and physicist which is of mutual advantage in their collaboration.

Chemistry is also becoming more serviceable to medicine and all the biological sciences. The psychiatrist is now coming to the chemist for help. Many forms of mental disorder appear to arise from disturbances of metabolism which are revealed by chemical studies, and there is hope that methods of treatment may be found to correct the errors so discovered. If only some forms of insanity can be cured, it would be at least a partial solution of one of the most painful human problems. "Extending this idea, may we not believe that even the psychologist will have to pay attention to chemistry ? So intimately interwoven are the activities of mind and body that no one can deny that the psychology of the individual is greatly affected by the hormonic balance which is part of his physical constitution ; and hormones owe their specific influence in the body to particular aspects of their molecular structure". Chemistry in fact is ubiquitous, though it required the Great War to make Great Britain realize the truth of Disraeli's dictum that the prosperity of the chemical industry is the best index of the prosperity of the country as a whole.

The distinction between pure and applied science is becoming less real, and it is probable that never before has organic chemistry shown more possibility of continued development. How remarkable in *kind* the development of organic chemistry has been in its apparently static time. The product of a pictorial, or even artistic rather than mathematical type of intellect, the evolution of the idea of molecular structure was something new and distinct, and the verification by modern physical methods of the conclusions reached is indeed remarkable. Organic chemistry in approaching physics is becoming more dynamic and more subtle.

Biochemistry is a borderland subject (not a hybrid, because it is certainly not infertile), and borderland workers usually find work not found by the cultivators of either of the contiguous regions. Intellectual trust and sympathy between two departments may be very fertile. Biochemistry is the study of chemical dynamics as exhibited in life, and requires a knowledge of the physical properties and molecular structure of the substances which play an essential part in the constitution of living systems. Its special endeavour must be to follow so far as possible the function and fate of each significant constituent amid the multitudinous reactions which underlie the manifestations of life, and to explore the mechanisms which control those reactions. For this work, biochemistry is developing its own technique, and its progress though difficult is real. While immersed in problems so different in kind, it is almost impossible for the specialized biochemist to acquire the knowledge and experience, or the mode of thought and intuitions of the accomplished organic chemist, in determining molecular structure and in the difficult art of synthesis. Even the best biochemist must remain an amateur in organic chemistry. There never was a case in which progress could be better secured by a wise division of labour. Recently organic chemists have been examining the structure of natural products with marked success.

Sir Frederick concluded with a eulogy of the work of the Birmingham University School of Chemistry, referring in particular to the synthesis of vitamin C, the commercial manufacture of which means that no case of scurvy need in future remain uncured.

Standardization of Physical Units

IN a paper by Lyman J. Briggs, director of the National Bureau of Standards at Washington, which appeared in the January issue of the *Journal of the Franklin Institute*, some of the present-day problems in connexion with securing international uniformity in standards are discussed.

The British inch, derived directly from the imperial yard, is about four parts in a million shorter than the United States unit. But if we use the conversion factor so that one inch equals 25·4 millimetres exactly, then the new value of the inch would fall midway between the British and the United States inch. The Bureau of Standards has definitely proposed that this be done. The change would not affect industry in the slightest because it falls well within the tolerances in industrial measurements. This conversion factor, one inch equals 25·4 mm., has recently been adopted for industrial purposes by standardizing groups in fifteen countries including both England and the United States.

In the field of electricity, the tools of measurement now depend on national standardizing laboratories. The maintenance of units is made possible on a world-wide basis by the rise of the great national standardizing laboratories, especially in Germany, Great Britain and the United States. The revision of the units is under way at the present time. But as the present units are more than sufficiently accurate for industrial use, the changes made will only affect laboratories making very precise measurements. The change will become effective on January 1, 1940. The present 'international' units of the ampere, ohm and volt will be respectively 0·9999, 1·0005 and 1·0004 of the new (absolute) ampere, ohm and volt respectively.

The present standards for use in photometry are either flame standards or carbon filament lamps giving light of a yellowish colour, and there is no general agreement as to a method regarding a method of passing over to lamps giving 'whiter' light. The German-speaking countries also never accepted the old 'international candle' but use their own unit, the Hefner, which is only nine tenths of it. Now that the Bureau of Standards has determined the behaviour of the normal eye in terms of 'factors of luminosity' which have been internationally agreed, a basis has been fixed for measuring lights of any colour provided we have some kind of standard as a starting point. We have still to agree upon the photometric scale for the brightness of the primary standard. The Bureau of Standards has recently suggested that the old 'international candle' be abandoned and that a slightly different unit be fixed by taking the round value of 60 candles per sq. cm., instead of the old value of 58·9, as the brightness of the blackbody radiator at the platinum point.

Science News a Century Ago

The Engineering Branch of the Royal Navy

ON July 19, 1836, an Order in Council was promulgated which for the first time granted permanent rank to engineers serving in the Navy and laid down the regulations for the training and employment of engineers. The Order in Council began: "Having had under our serious consideration the situation of the Engineers of Your Majesty's steam vessels, and being of opinion that it is necessary to place this description of officers on a permanent footing, in the same manner as the Gunners Boatswains and Carpenters in Your Majesty's Navy, with such rank and pay as appears to be fitting for persons charged with the performance of such important and responsible duties, we beg leave most humbly to entrust for Your Majesty's most gracious consideration and approval the following regulations. . . ." The engineers were to be appointed in the same manner as other warrant officers; they were to rank next below carpenters; they were to be distributed into three classes and they were to be allowed to retire upon superannuation upon the scale laid down for warrant officers in 1826. The pay of a first-class engineer was to be £9 12*s*. a month, and sixpence a day for each apprentice or boy that may be placed under his instruction; the pay of a second class engineer was to be £6 16*s*. a month and that of a third class was to be £4 18*s*. a month. On entry into the service engineers had to pass an examination before the Chief Engineer and Inspector of Machinery or such other officer as might be appointed for that service.

The Order concluded with: "And with a view of encouraging the education of youths in Your Majesty's Service for Engineers, we beg leave further most humbly to propose that Your Majesty will be graciously pleased to establish four classes of Apprentices or Engineers' Boys, for the service of Your Majesty's steam vessels, with the following rates of pay: 1st Class, £1 14*s*.; 2nd Class, £1 6*s*.; 3rd Class, £1 3*s*.; 4th Class, 14*s*. 6*d*. a month."

Launch of *S.S. Great Western*

ON July 19, 1837, the S.S. *Great Western*—the *Queen Mary* of her day—was launched at Bristol. Designed by Isambard Kingdom Brunel and built by Patterson for the Great Western Steamship Company, which had been formed at Brunel's suggestion for connecting Bristol with New York, she was the largest vessel constructed up to the time she was launched. She was 236 ft. long, 35⅓ ft. beam, 59 ft. wide over the paddle boxes and of 1,320 tons. "Her scantling," wrote one author, "is equal in size to that of our line of battleships, it is filled in solid, caulked within and without up to the first futtock heads before planking, and all above this height is of English oak. The flooring is of immense length, each floor overrunning the other; they are strongly dowelled and bolted in pairs first and also together by 1⅛ in. bars of 24 ft. in length, driven in parallel rows, scarfing about 4 ft. She is trussed in the firmest and closest manner by iron and wooden diagonal and also shelf pieces, these including all the upper works, are fastened with screws and nuts to an immense extent." After being launched, the ship was towed to the Thames to have her engines fitted. She made her first voyage to America in April 1838.

Meteorology in the United States

AT the fifty-fourth quarterly meeting of the Franklin Institute of Philadelphia held on July 20, 1837, the report submitted contained the following statement: "Whereas, a considerable number of members of this Institute, in conjunction with members of the Philosophical Society, have recently devoted much time to the observations of the phenomena accompanying the various conditions of the atmosphere, with a view to ascertain the general laws by which the changes of weather are governed; and the belief is confidently entertained, that a continuance of these observations, and their extension over the widely spread territory of the United States, will enable us to determine many general facts of a highly important and useful character, therefore, Resolved, that the Joint Committee of the American Philosophical Society and the Franklin Institute be, and are hereby authorized, on the part of this Institution, to memorialize Congress for the purpose of obtaining the national aid in furtherance of this interesting object."

University Events

ABERDEEN.—The following degrees of D.Sc. have recently been awarded: E. M. Dodds, for a thesis entitled "Researches on the Internal Combustion Engine and its Fuels"; Dr. A. W. Downie, for a thesis entitled "Studies on Immunity to the Pneumococcus"; Dr. D. S. Raitt, for a thesis entitled "Stock Replenishment, Fishing Intensity, Yield Prediction and Ancillary Problems in relation to the Haddock Stocks of the North-East Atlantic"; Dr. H. E. Shortt, for a thesis entitled "Life-history and Morphology of *Babesia canis* in the Dog-Tick *Rhipicephalus sanguineus*".

The honorary degree of LL.D. has been conferred on Prof. T. Shennan, emeritus professor of pathology in the University.

BELFAST.—The degree of D.Sc. has recently been conferred on the following: Prof. W. A. Osborne (*honoris causa*), M. J. Lynn (botany) and R. H. Sloane (physics).

CAMBRIDGE.—The following University appointments have recently been made: Dr. O. M. B. Bulman, lecturer in palæozoology; Dr. J. K. S. St. Joseph, demonstrator in geology; M. Black, demonstrator in geology; J. D. Boyd, lecturer in anatomy; Dr. W. A. H. Rushton, lecturer in physiology; S. J. R. Reynolds and C. D. P. Jones, demonstrators in anatomy; A. L. Hodgkin, demonstrator in physiology; and Dr. G. N. Myers, demonstrator in pharmacology.

A. M. Barry has been appointed to a Frank Edward Elmore studentship as from October 1.

The Frank Smart prizes have been awarded to B. G. Wilkinson, Downing College (botany); M. G. M. Pryor, Trinity College (zoology).

Applications are invited for the Gwynaeth Pretty studentship, the holder of which shall devote himself to original research in the etiology, pathology and treatment of disease, with particular but not exclusive reference to those diseases which cripple or disable in childhood or early life. The studentship is of the annual value of £200 and is tenable for three years. Further information can be obtained from Prof. H. R. Dean, Department of Pathology.

Societies and Academies

Edinburgh

Royal Society, Edinburgh, June 7, 1937.

H. S. Taylor: Heavy hydrogen in scientific research (Bruce-Preller Lecture). Heavy hydrogen has led to interesting developments in theoretical and experimental aspects of reaction kinetics, especially in the fields of catalysis and photochemistry. Problems of molecular structure involving all types of spectral analyses of deuterium-containing compounds have also been solved. The biological and astronomical aspects of the problem were discussed, and the important role of deuterons, at high voltages, in the production of artificially radioactive elements and isotopes of known elements, particularly in the field of radiotherapy, was indicated.

A. C. Aitken: Studies in practical mathematics. (2) The evaluation of the latent roots and latent vectors of a matrix. The paper develops and exemplifies a method, based on the repeated transformation of a vector, for finding all the roots and characteristic vectors of the secular equation and more general determinantal equations. By a simple auxiliary process a few poor or moderate first approximations are shown to be capable of yielding second and later approximations of high accuracy. Numerical examples are used to illustrate the routine of computation, which is well adapted to modern machines.

F. A. E. Crew and Ch. Auerbach: 'Spheroidal': a mutant in *Drosophila funebris* affecting egg size and shape, and fecundity. 'Spheroidal' eggs are broader and shorter than normal, with greater variability in both dimensions and also in the shape index. These differences, as well as the abnormal curves of regression of length on width and of volume on length, suggest fundamental deviations from the normal processes concerned in egg development. 'Spheroidal' females are remarkably infecund, and differ from normal in respect of the curve of laying performance from day to day.

Francis Greenshields: Studies in the cytology of parthenogenetic reproduction of Hymenoptera Symphyta. (1) Chromosome number and individuality in three arrhenotokous species. The complement of O chromosomes in the male germ-tract of three arrhenotokous species of Hymenoptera Symphyta consists of 4 'morphological' pairs, and that for one of these species the 16 chromosomes in the female germ-track consists of 4 groups of 4, corresponding to the pairs in the male. Sex chromosomes are not distinguishable; which fact does not favour application of Whiting's theory of sex-determination to Hymenoptera Symphyta. It is suggested that true relationship between the sexes is of tetraploidy to diploidy, and that initial emergence of the parthenogenesis has been by polyploid evolution.

Paris

Academy of Sciences, May 24 (*C.R.*, 201, 1517–1596).

Lucien Cayeux: New data on the existence of bacteria in the old sedimentary rocks. The results of work done on ferruginous oolites, with the aid of infra-red microphotographs. The existence of bacteria in the seas is proved back to the Huronian; they probably made their appearance still earlier. It is possible that bacterial action exercised a preponderating effect in sedimentary formations.

Alexandre Guilliermond and Roger Gautheret: The property possessed by plant cells of excreting neutral red after having accumulated it in their vacuoles.

Louis Blaringhem: The double fertilization of flowering plants and the separation of the hybrids: from the correspondence of Hugo de Vries and Léon Guignard.

Serge Bernstein: Modification of the quadrature formula of Tchebycheff.

Lucien Daniel: New researches on the variations of the apogamous dandelion.

Maurice Nicloux: The proportion of alcohol in water from the interstitial plasmas and of protoplasmic water, in an aquatic animal, is that of the external medium in which it is immersed. Experimental demonstration for the frog.

W. Slebodzinski: The realization of a variety with affine connexion by a surface plunged in an affine space.

Paul Gillis: The equations of A. Haar of the calculus of variations.

Charles Jacob: The Gibbs phenomenon in the development of series of Hermite polynomials.

Robert Fortet: Linear operations not completely continuous.

Henri Corblin: A compressor with two membranes for use with gases forming dangerous compounds with lubricants.

Léopold Escande and Georges Sabathé: A weir inclined with respect to the axis of a canal.

Mme. Marguerite Moreau-Hanot: The theoretical study of toroidal high-tension collectors.

Georges Bodier: The influence of the earth circuit of lightning protectors in an electrical network.

Robert Forrer: The electronic lattice of the transition elements.

Henri Lacoste-Tayan: The cycles of recoil of magnetic steels.

Marcel Laporte: A law of emission of a radiation with continuous spectrum (white light) by xenon tubes.

Mohammad Monadjémi: The materialization of the energy of the β-rays of thorium B+C.

François Bourion and Emile Rouyer: The determination of the hydration of the ions of calcium nitrate.

Jean Cournot and Marc Baudrand: The corrosion of riveted joints. Supplementing work described in a previous communication. The conditions of working are similar, but the two plates are of different materials.

Marcel Servigne and Etienne Vassy: An application of luminescence to quantitative analysis: the micro-estimation of the element samarium. In the particular case of samarium in very dilute solid solution, the intensity of the band studied is proportional to the concentration of the active element. With concentrations between $1{\cdot}07 \times 10^{-4}$ and $0{\cdot}082 \times 10^{-4}$ grams per gram of diluent (calcium tungstate) the accuracy of the measurements is about 5 per cent.

René Dubrisay and Georges Arditti: The alteration of metals by carbon tetrachloride in the presence of water. Results obtained with copper and zinc are given.

Mlle. Yvonne Garreau: The oxidation of hydroquinone by air in the presence of *n*-butylammonium sulphite.

Marc Bassière : The structure of cadmium nitride (hydrazoate). Description of the method employed for obtaining cadmium hydrazoate in pure crystals, with details of the crystallographic and X-ray study.

J. Malavoy and F. Jacquet : The geological formations of Portuguese Guinea.

Mlle. Marguerite Frollo : Study of the submarine breccias containing dolomitic elements in the dolomitic Trias of the eastern Carpathians.

Nicolas Stoyko : The periodic variations of longitude.

Edouard Boureau : The presence of tracheids in the alternate wood of the radicle of conifers.

Marcel Mascré and René Paris : The constitution of scoparoside (scoparine) of *Sarothamnus scoparius*. Scaparoside is a heteroside of the formula $C_{22}H_{22}O_{11}$, hydrolysable with difficulty, giving a molecule of rhamnose and a molecule of a flavone derivative, probably a quercitol methyl ether.

René Souèges : The embryogeny of the Plumbagineæ. The development of the embryo in *Armeria plantaginea*.

André Tournade and Marc Chevillot : Does the action of the vaso-dilator nerves amount to a liberation of acetyl-choline ?

Philippe Joyet-Lavergne : Distinguishing the zones of oxidation in the living cell by the method of cobalt salts. In the living cell, whether plant or animal, the chondriome and the nucleole are two constituents which possess a catalytic oxidizing power sufficiently great to transform cobaltous salts into cobalt salts, a change shown clearly by the colour change.

Yves Le Grand : The apparent rhythm of flickering.

Maurice Fontaine and René Guy Busnel : The localization and the nature of the flavine contained in the skin of the eel.

Auguste Lafay and Bernard Lafay : The introduction of artificial radioactivity into therapeutics.

Geneva

Society of Physics and Natural History, May 20.

P. Rossier : (1) Definition of stellar colour indexes. Photometers used for the determination of colour indexes are generally standardized in such a manner that the index is zero for the A_0 stars. There may be an advantage, especially in the case of photo-electric cells, in considering the index as the difference of two magnitudes, omitting this adjustment. (2) The Wien-Planck correction in the calculation of the magnitude of a star. This calculation makes use of certain sums the handling of which is somewhat inconvenient. It is possible to replace these by certain exponentials, with an error which never exceeds 0·03 magnitude.

J. Ph. Buffle : The origin of the calcium bicarbonate in the waters of the River Versoix (Canton of Geneva). The river contains no free carbonic acid, and is not capable of dissolving the limestone which forms its bed. As, on the other hand, the proportion of calcium bicarbonate increases from the source of the river to its mouth, the origin of the salt must be external to the river. It is brought in by waters of infiltration, which fulfil the necessary conditions for dissolving the chalk of the strata which they traverse.

G. Tiercy and P. Javet : The pulsation of variable stars of the Cepheid type. A study of the case where the periodic variation of the ray includes two terms, one of which has a period double that of the other.

P. Balavoine : The variation of the iodine value of drying oils according to their origin. The iodine values of drying oils, particularly linseed oil, vary according to the country of origin and the season during which they have been prepared. The value is higher when the oil is prepared at a higher temperature.

Vienna

Academy of Sciences, April 22.

H. Molisch : Influence of one plant on another which is remote from it. The principal results are given of a research arising out of the well-known property of ripe apples of accelerating the ripening of unripe ones stored with them. The full results are to be published in book form.

S. Meyer : The age of the sun, the decay constant of actino-uranium and the ratios of the amounts of lead, thorium and uranium on the earth.

N. v. Szentpály : Heating effect of radioactive minerals. A combined micro-calorimeter and thermostat is described.

F. Viehfeger : Loss of charge of α-particles in helium. For particles of velocity $1 \cdot 08 \times 10^{9}$ cm./sec., the mean free paths for capture and loss are 11·3 times the corresponding values for air.

M. Mladenovic : Nature of manilla resin.

E. Beutel and A. Kutzelnigg : Production of a brilliantly fluorescent zinc oxide by partial decomposition of basic zinc carbonate.

E. Kruppa : Projective geometry of a Hermitian plane.

R. Inzinger : Geometry of the Monge-Ampère differential equation of the second order.

J. Krames : (1) Cubic circular motion of space. (2) Geometry of the Bennett mechanism.

J. Pia : Recent researches on the Cetacea of the Vienna Miocene.

K. O. Felser : Stratigraphically important corals from the upper Nassfeld strata and the Trogkofel chalk of the Carnic Alps.

G. E. Kielhauser : Carboniferous flora from the leat of the mill near the Rattendorf meadow in the Carnic Alps.

April 29.

Franziska Seidl : Observations of the diurnal variation of the electrical conductivity of the air in Fulpmes in the Stubai valley.

K. Ehrenberg : Two new remains of primates from the Miocene of Lower Austria. A right ulna and a humerus bone are described which possess characteristics of both the anthropoids and the lower primates. They are believed to belong to a new species which has been named *Austriacopithecus weinfurteri*.

May 7.

K. Hillebrand : Evolution of cosmic dust clouds. A permanent change in the distribution of matter which is initially uniformly dispersed can be brought about by inelastic collisions.

E. W. Kellermann : Coloration and luminescence of fluorite.

K. Graff : Visual colour excess of bright stars near μ Cephei.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TWO UNIVERSITY DEMONSTRATORS IN ENGINEERING in the University of Cambridge—Secretary of the Appointments Committee, Engineering Laboratory, Cambridge (July 17).

DEMONSTRATOR IN CHEMISTRY in King's College, London—The Secretary (July 20).

LECTURER IN PHYSICS (subsidiary mathematics) in the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Education Offices, Town Hall, Hanley, Stoke-on-Trent (July 22).

DEMONSTRATOR IN ELECTRICAL ENGINEERING in the Military College of Science, Woolwich, S.E.18—The Commandant (July 30).

A FIELD GEOLOGIST for the Iraq Government—The Royal Iraqi Legation, 22 Queen's Gate, London, S.W.7 (July 31).

LECTURER IN HUMAN EMBRYOLOGY AND HISTOLOGY in the University of Glasgow—The Secretary (August 6).

DIETICIAN OR NUTRITIONIST for the Board of Education—The Secretary, Board of Education, Whitehall, S.W.1 (August 7).

ASSISTANT at the Royal Observatory, Greenwich—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (August 7).

MUSEUM ASSISTANT in the Woolwich Borough Museum—The Town Clerk, Town Hall, Woolwich, S.E.18 (August 31).

CURATOR of the University Museum of Archæology and Ethnology in the University of Cambridge—The Registrary (October 1).

FOULERTON RESEARCH FELLOWS IN MEDICINE of the Royal Society—The Assistant Secretary, The Royal Society, Burlington House, W.1 (October 16).

ESTABLISHED CIVIL ENGINEERING ASSISTANTS and an **ASSISTANT ENGINEER** in the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W.C.2.

TEACHING SCHOLAR in the Department of Zoology, University of Birmingham—The Secretary.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records, No. 17 (Wood Preservation Series, No. 3): Wood Preservatives. By N. A. Richardson. Pp. iii+13. (London: H.M. Stationery Office.) 6*d*. net. [36

Royal Meteorological Society. *Bibliography of Meteorological Literature.* Prepared by the Royal Meteorological Society with the Collaboration of the Meteorological Office. Vol. 4, No. 2 (July–December 1936). Pp. ii+55–116. (London: Royal Meteorological Society.) 2*s*. 6*d*. [36

Peace Year Book 1937. Pp. 418. (London: National Peace Council.) 2*s*. [36

The Lister Institute of Preventive Medicine. Report of the Governing Body, 1937. Pp. 28. (London: Lister Institute.) [46

Home Office, Ministry of Health and Scottish Office. Interim Report of the Inter-Departmental Committee on the Rehabilitation of Persons injured by Accidents. Pp. 20. (London: H.M. Stationery Office.) 4*d*. net. [46

British Polar Year Expedition, Fort Rae, N.W. Canada, 1932–33. (Published under the direction of the British National Committee for the Polar Year, The Royal Society, Burlington House, London.) Vol. 1: Discussion of Results; Meteorology, Terrestrial Magnetism and Aurora, Atmospheric Electricity. Pp. xv+336+5 plates. Vol. 2: Tables; Meteorology, Terrestrial Magnetism, Atmospheric Electricity. Pp. ix+228. (London: Percy Lund, Humphries and Co., Ltd.) [46

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1937 June 5. Pp. 38. (Greenwich: Royal Observatory.) [76

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 1, No. 4: The Structure and Function of the Alimentary Canal of some Species of Polyplacophora (Mollusca). By Dr. Vera Fretter. Pp. 119–164. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 5*s*. 9*d*. [76

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The Future of the South African Protectorates

THE statement made by General Hertzog, Prime Minister of the Union of South Africa, on his return from attending the recent Imperial Conference in London, which dealt with the question of the transfer of administrative control of the South African native Protectorates to the Union (*The Times*, July 7), has raised a grave issue in the gravest possible manner. He accuses the British Government of a dilatoriness virtually amounting to bad faith, and in the event of further delay, foreshadows an appeal to the Crown, of which the consequences both to Great Britain and South Africa would be so incalculable, that he is not prepared to accept as final the British minister's reply to pressure for early transfer.

General Hertzog clearly intended a reply to certain opinions expressed in the House of Lords in the debate on Lord Noel Buxton's motion on June 9 (see NATURE, June 26, p. 1083). When he went on to speak of the Government's attitude as dictated by the ballot box, he descended to a mere piece of political invective, worthy neither of its author nor of South Africa's case.

It cannot be denied that South Africa has a case; and the interests of the Protectorates afford strong, indeed almost overwhelming, argument in support of that case on geographical, economic and administrative grounds. The territories are, and must always be dependent economically upon the Union. They have no natural effective outlet except through the Union; they are dependent upon it for the employment by which their labour makes up the deficiencies of their capacity to produce. On the side of the Union any serious disparity in administrative methods might at any moment aggravate difficulties in dealing with its own native question. Nor should it be overlooked that the Union has been generous in assistance to the Protectorates in a time of stress, although that assistance may have been granted under a misapprehension, for which General Hertzog himself is largely responsible.

Mr. Malcolm MacDonald, the Secretary of State for Dominion Affairs, showed in the House of Commons on July 9 that there had been a complete misunderstanding of the position. There had been no undertaking that transfer would be effected within any specified period. Once more he enunciated in terms the pledge, which was again repeated in the House on July 13, that no action would be taken without previous consultation of the inhabitants of the Protectorates, white and native, though he could not be brought to the point of a categorical statement that without consent there would be no action.

In delaying transfer, the British Government has displayed supreme wisdom. In the eyes of informed opinion—and in this matter the House of Lords is perhaps a better gauge of public feeling than the House of Commons, hence General Hertzog's aggrieved reference to its periodical pronouncements—the time is not yet ripe. For this the attitude of the Union Government on the native question is as much, if not even more responsible than the admitted reluctance of the Protectorate native populations to acquiesce in the change of administrative rule.

Since the passing of the South Africa Act of 1909, a great change in outlook has taken place in matters affecting the welfare and the administration of the affairs of backward peoples. At that time the anthropologist was urging the imperative necessity for scientific study of native institutions and beliefs as a basis for sympathetic administration of native affairs. In South Africa the Government had embarked on a policy which seemed to hold out to the native an avenue of approach to a useful participation in citizenship and a share in the future development of the country through the organization of native councils. Great Britain, therefore, at that time felt justified in looking forward to a day when all the natives of South Africa might pass to South African control. Events in the political, economic and industrial history of the Commonwealth have falsified anticipation. The problem of the native population, which as a sociological question should be approached in the spirit of scientific and objective inquiry, has become an issue in party politics, while the trend of legislation, notwithstanding pledges to initiate a more liberal course of action when once the 'menace' of the native franchise was removed, has been to strengthen the colour bar and to emphasize the social and economic disability of the 'inferior' race, through the policy of segregation. It is not the least disquieting feature of the present situation that a certain section of advanced native opinion is strongly in favour of segregation and the complete separation of the two races in the interests of the native himself.

As a self-governing Dominion, it is South Africa's business to deal with her native problem as seems to her best. A white population outnumbered by the native in the proportion of four to one has need of provident statesmanship if it is to preserve its supremacy without crippling its powers of expansion. There is, however, in South Africa a growing section of opinion, in which the anthropological school of thought counts for much, that sees in the present policy of segregation as enforced by legislation, no way out for the native towards further development. In present conditions, it is true, some measure of training in various directions, educational and vocational, lies open to the native, though these conditions are perhaps less favourable than they were a generation ago. But there is little scope for the exercise of the native's powers and energy when once he is trained. For this *impasse*; the anthropologist would seek to substitute conditions such as a scientific and dispassionate survey of the situation would suggest. These, he is confident from his knowledge and experience, would, without turning the native into a black European, open the way to growth along lines congenial to native character and institutions, and yet would admit him to a share in the development of the country, to the advantage of white and native communities alike.

These matters, however, are for the Union of South Africa to decide; but the appearance within the Union of a body of opinion critical of the dominant policy is not without its lesson for the people of Britain. Under the Imperial Parliament, the policy of native administration has virtually ceased to be a political issue. In general, parties are now united in accepting the doctrine of 'trusteeship' as the principle of government of the backward peoples of the Empire; and that in appropriate circumstances, "the interests of the native shall be paramount", has been enunciated repeatedly as the decisive formula of British native administration. In the South African Protectorates under the administration of British officials, circumstances have brought about a system of control, which if not technically 'indirect rule', approaches that method of government in some near degree. Under that system, a process of acculturation has been taking place, which is producing a system of religious belief and social organization, that if neither entirely European nor wholly African, has something of each, and yet—and this is the important factor—is both congenial to the African temperament and affords, in the eyes of competent judges, a potentiality of further cultural development along progressive lines. What those lines should be, it is the opportunity and the obligation of scientific study to assist in determining in the light of the effects of the cultural impacts which are now taking place—in short, the function of the 'applied anthropology' for which the Royal Anthropological Institute has recently appointed a standing committee (see p. 145).

Apart from the question of the obligation imposed on the Imperial Government by its pledge to consult the inhabitants of the Protectorates before any action is taken in the matter of the transfer of their administration to the Union, the crux of the problem lies in the temper with which the people of the Union of South Africa attempt to solve the problem of their own native population. Unless this is such as to afford a reasonable guarantee that it will foster rather than frustrate the steps, slow and hesitant they may be, now being taken by the natives of the Protectorates towards a cultural development, which may truly be regarded as a progress in civilization, the British Government should see no alternative but to hold its hand.

Evolution of the Holarctic Fauna and Flora

Die Holarktis:
ein Beitrag zur diluvialen und alluvialen Geschichte der zirkumpolaren Faunen- und Florengebiete. Von W. F. Reinig. Pp. vii+124. (Jena: Gustav Fischer, 1937.) 7.50 gold marks.

ONE cannot fail to agree with the author's remark in the preface to this interesting book, that the rapid recent development of ecological science has served, to some extent, to obscure the intrinsic value of biogeographical studies, which often tend to be regarded as a mere branch of ecology. Actually, biogeography, or the study of the composition, origin and evolution of the living faunas and floras, represents a higher degree of synthetic biological knowledge than either ecology or faunistics (or floristics), on both of which it largely relies for its fundamental data. The book under review must be regarded, on the whole, as a very successful attempt to treat the problem of the Holarctic fauna and flora on broad biogeographical and evolutionary lines.

The indisputable fact that the greater portion of the territory of Holarctis was either covered by Quaternary ice, or experienced the climatic effects of glaciations, was apparently the reason which made the author restrict his analysis only to the later stages of Pliocene and to Pleistocene. This course certainly simplified the task very greatly; but it can scarcely be justified in the face of many distributional facts, which obviously have their origin in much earlier geological periods. The volume of reliable palæontological data on the distribution of life in the present Holarctic region during the Tertiary is very considerable, while geological data permit one to form some judgment with regard to the Tertiary climates, as well. The restriction of the field of study is, therefore, largely artificial, and makes the results less complete and convincing than they might have been.

The main thesis of the book, developed at considerable length and with abundant supporting evidence, is that the present distribution of Holarctic animals and plants can be explained on the basis of their evolution during, and under the influence of, repeated glaciations and of warmer interglacial periods. The maximum glaciation in the Eurasian continent forced the temperate preglacial forest flora and fauna to retreat to four main 'refuge areas', namely: (1) Mediterranean; (2) Armeno-Persian; (3) Central-Asian (consisting of three separate parts—Afghanistan, Tian-Shan and northern Mongolia); and (4) Eastern-Asian (including south-eastern China and Japan).

In North America, the flora and fauna of the same pre-glacial type retreated also into four refuge areas: (1) Atlantic, comprising Florida and adjoining lowlands; (2) Mexican (subtropical); (3) Pacific, extending along the southern Rockies; and (4) Alaskan. The subsequent retreat of glaciers resulted in re-invasion of more northern regions from the refuge areas, where in the meantime distinct races and even species were produced by isolation. This re-invasion was not simultaneous everywhere, since the maximum glaciation, according to the author, both commenced and ended in Europe and in North America earlier than in Asia. This accounts for the considerable European element in the present Siberian fauna, and for the great affinities of the latter with the American one. Certain elements were slower in the reinvasion, and some of them remained restricted to refuge areas and represent well-known examples of discontinuous distribution. Repetition of retreats and advances of animals and plants during successive glaciations served to complicate the resulting distribution still more, and some of the details cannot be elucidated as yet.

Of course, this is only a very brief and greatly simplified summary of the author's ideas, which are developed with a wealth of data. These ideas certainly appear sound and well documented, if not wholly new. It is, however, obviously inconsistent to disregard the influences to which the Holarctic fauna and flora must have been subjected from the more southern zones of the continents under study. The author attributes to glacial climates the power to drive animals and plants into what are now subtropical zones; but he appears to ignore a northward pressure of subtropical elements (or those derived from them) during the warmer inter-glacial periods. If the displacements of climatic zones are admitted, it is only logical to study all their implications, including the influence of southern faunas and floras on those of Holarctis. The author prefers to be one-sided in this respect, and goes so far as to state that the present Mediterranean and even the Eremian zone cannot be separated from the Holarctic because they partly served as refuge areas for Holarctic plants and animals during glaciations. Such a sweeping disregard of deep ecological, floristic and faunistic differences which exist between deserts and temperate forests will not be accepted by other biogeographers.

A similar disregard of ecology is apparent in many parts of the book, representing probably a reaction against undue preponderance of the ecological point of view in modern biogeography. As an example, it is sufficient to point out that the author uses the words 'steppe' and 'desert' almost as synonyms, and often speaks of "Steppen und Wüsten" as of a single biogeographical unit, while there is nothing but a superficial similarity between these two types of habitat, which are profoundly different in their distribution, climate, ecology and in their plant and animal population.

It would be easy to criticize various lesser points in the author's theories, but this would be scarcely fair, since the book is clearly a first and incomplete attempt to present a connected evolutionary history of the Holarctic fauna and flora. The author has certainly succeeded in conveying the idea of slow climatic changes causing movements of plants and animals, and resulting in complicated distributional patterns of the present day. For this alone the book must be regarded as an outstanding contribution to biogeography in the modern sense of the word, and is certain to lead to fruitful discussions and to stimulate new researches. B. P. UVAROV.

Early Science in Cambridge

Early Science in Cambridge
By Dr. R. T. Gunther. Pp. xii + 513 + 68 plates. (Oxford: The Author, The Old Ashmolean, 1937.) 42*s*. net.

A GOOD many years have passed since Dr. R. T. Gunther began to discover at Oxford the great store of old astronomical, mathematical, and other scientific instruments which enabled him to illustrate the development of scientific studies in that University from their earliest beginnings; discoveries that have resulted in the preservation of much valuable material, which might easily have been lost, in the admirable Museum of the History of Science which he has arranged in the Old Ashmolean building.

Having thoroughly explored the resources of Oxford, it was natural that Dr. Gunther should turn his attention to Cambridge. There he found that while the existence of interesting objects was known to a few, no one had made a systematic examination of the ground. When, therefore, he expressed a desire to undertake this work, his suggestion was welcomed, and all necessary facilities were afforded him by those in a position to give him help. It was further arranged that an exhibition of the results of his labours should be set out in the Old Schools and be on view at the end of the Easter term, 1936. Dr. Gunther threw himself into this task with characteristic energy, and the results far exceeded all expectations.

From dusty cupboards in laboratories, from the corners of college libraries, and from seldom-opened museum drawers, he brought together a wealth of old apparatus which surprised even those who had some knowledge of the hidden treasures of Cambridge, and aroused great interest in numerous visitors during the all too short time the exhibition was open.

The historical and biographical notes which Dr. Gunther accumulated in the course of his researches, and the catalogue of the exhibition which he compiled form the basis of this book, which to do it justice must be regarded more as a source book than as an orderly treatise.

In his introductory chapter, Dr. Gunther wisely deprecates unprofitable controversy as to the relative age of our two ancient universities, and leaves their origins wrapped in the mists of antiquity, but by interesting quotations from William Harrison (1577), and other early writers, he shows the convenience and importance of the site of Cambridge at the head of a navigable water-way by which commodities could be brought to the town when roads were but miry tracks. The paragraphs headed "Roads and Communications", "Travel by Air", and "Railways", contain information which will be new to most Cambridge residents to-day, and the clauses relating to Cambridge in the Assessing Act for the Eastern Counties Railway, printed *in extenso*, give an amusing account of the obstacles placed by the University in the 'forties in the way of any of its younger members who wished to travel by train. A brief account of Fen drainage schemes and notable floods has especial interest in view of recent experiences.

The second chapter, entitled "Mensuration", is essentially an excerpt from the exhibition catalogue, prefaced by some historical matter relating to Sturbridge Fair and to the University in its capacity as an inspector of weights and measures.

Dr. Gunther deals next with mathematicians and mathematical instruments, and following the method he employs throughout the rest of his book, gives in chronological order brief biographical sketches of the eminent men who have cultivated this study in Cambridge, incidentally rescuing from oblivion many lesser lights. Thus, while Newton holds the field, Briggs, Oughtred, Seth Ward, Barrow and others are not forgotten, and the chapter is illustrated with excellent plates of the splendid set of mathematical instruments made for Roger North and now in the possession of Jesus College, and of the perfect specimen of Oughtred's circular slide rule which came to light in the Cavendish Laboratory.

Mechanics and physics are dealt with in the same way, the great wealth of material being handled under such sub-headings as weighing the earth, sound, heat, light and colour, magnetism and electricity.

A long and richly illustrated chapter is devoted to astronomy, and as is but natural, much space is allotted to astrolabes and sun-dials. It may, however, be doubted whether the importance of Dr. Dee justifies the amount of attention given to him.

Two short chapters dealing with geography and meteorology bring us to chemistry. Here the somewhat elusive figure of Vigani, the first professor of chemistry, comes to life with his cabinet of materia medica still preserved at Queens' College, and the better known names of Smithson Tennant and Wollaston receive adequate attention.

Chemistry leads on to medicine, and while "pestilence walks at noon day", a strange assortment of practitioners and quacks passes across the stage. This chapter is packed with curious lore, and leaves the reader with a wholesome respect for the stamina of those of our ancestors who managed to survive the attentions of their medical attendants.

Anatomy, physiology and pathology are dealt with next, and on almost every page will be found the record of some curious fact or the revelation of some quaint personality. Particularly interesting are the accounts of the researches of Glisson and Stephen Hales.

In the account of zoology, John Ray and his friend Willughby hold pride of place. Two of Ray's letters are reproduced in facsimile, and a number of others now published for the first time are to be found in an appendix. Ray, too, is prominent in the section devoted to botany, and Stephen Hales tells the story of some of his most important botanical discoveries in his own words.

The study of geology in Cambridge, being based on the foundation of Dr. Woodward, it is interesting to have before us his will *in extenso*. It can only be regretted that the annual inspection of his collections, to be followed by a dinner, to which he attached so much importance, has been allowed to fall into abeyance.

The appendixes with which this work concludes are not the least valuable part of it, and Sir Thomas Sclater's practice of fruit and fish culture towards the end of the eighteenth century will have interest for many.

Up till the middle of last century, it was still possible for one man to attain distinction in more than one branch of science. The arrangement of the matter of this book under subjects leads, therefore, to the appearance of the same individual in different categories and tends inevitably to a certain amount of repetition. This, with the intercalation of excerpts from the exhibition catalogue, produces a somewhat patchwork effect. The first inconvenience could scarcely be avoided, but if the catalogue had been printed as an appendix, the narrative would have become more continuous and satisfying.

In a work of this kind, some slips and misprints are bound to escape the vigilance of the author. Many have been noted, but not in undue number or likely for the most part to mislead a reader seriously. A few may be mentioned. Darwin worked at Downe, not Dover. Prof. G. H. F. Nuttall's name is unfortunately omitted from the list of the Quick professors, and the press set up in 1752, at which astronomical works were printed, had its home in Pembroke, and not, as might be inferred from p. 79, at Queens'.

Though the book suffers from a certain lack of orderly arrangement and from rather meagre documentation, a vast amount of interesting and entertaining information culled from a great variety of sources, many of them obscure, has been brought together within its covers. All Cambridge men should be grateful to Dr. Gunther for making it possible for them to become acquainted so pleasantly with the personalities, aims and achievements of their scientific forbears, and for compiling a work which should be in every college and departmental library. Senior members of the University who keep it handy on their shelves will find it a sort of scientific "Gunning", admirable for browsing in at odd moments; for most junior members it will probably prove too expensive.

In conclusion, we would re-echo the hope expressed in the author's preface, that among the institutions of the University a modest room or two may be found, where the more interesting and important of the exhibits got together last year, suitably displayed and labelled, may find a permanent home.

A. H.

The Structure of the Flower

Floral Morphology:
a New Outlook, with Special Reference to the Interpretation of the Gynæceum. By E. R. Saunders. Vol. 1. Pp. viii+132. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 3*s*. 6*d*. net.

THE history of plant morphology shows a number of more or less distinct phases. The earliest phase was one of description, including the recognition of morphological categories and the introduction of terms. Later the idealistic concepts of Goethe laid the foundation of much that is still orthodox. With the advent of Darwinism, there commenced a long period of explanation in terms of use and, on the whole somewhat later, attempts to trace the evolution of organs. At the present time, all these earlier phases seem to be revived in a new interest in plant structure, with the introduction of certain new methods and theories.

The vast majority of existing seed plants are characterized by possessing flowers clearly marked off from the vegetative parts of the plant body. The evolutionary history of the flower is still obscure and, even as a preliminary to research on this problem, there is an urgent need for clarification in our knowledge of the morphology of its component parts. Botanists are not all agreed as to whether it be a simple stem bearing modified leaves, a modified branch system, or essentially a structure *sui generis*. All parts have been subject to detailed and comparative examination: perianth, androecium, and gynoecium (gynæceum). The composition of the latter has, however, been the subject of most recent research. The numerous papers of Miss E. R. Saunders have made botanists familiar with the theory of carpel polymorphism. None will deny the importance of her work in directing attention to the many peculiarities of arrangement, anatomy, and behaviour to be found in the ovaries and their associated parts in both monocotyledons and dicotyledons. In a first volume on floral morphology, Miss Saunders summarizes her views on the architecture of the flower, with special reference to the gynoecium, in an introduction, and outlines on this basis the flower structure of thirty-nine families. A student unacquainted with the new concepts would probably find the book somewhat difficult reading, partly because of the very few illustrative drawings. The size, founts, general format, and low price of the book are all excellent, and it is to be hoped it will be widely read and used, especially as a guide to laboratory work by teachers and students. If it gives stimulus to the detailed dissecting of flowers and a study of their anatomy in academic institutions, it will have fulfilled a most important and urgent need.

The special theory of carpel polymorphism, which is the central theme of the book, is "in accordance with the view that in true apocarpy the individual ovary is formed of a single carpel, which arises as a separate structure, but that in syncarpous and pseudo-apocarpous forms it is composed of two kinds of carpels, sterile and fertile". Two main types of carpels are distinguished: valve and consolidated. The former shows pinnate venation, marginal ovules (when fertile), and when present alone generally forms an apocarpous gynoecium. The consolidated carpel has a pair of strongly developed bundles close to the mid-line (with or without a median bundle). The ovules are usually borne on either side of the mid-line, and the consolidated carpel is, in syncarpous ovaries, generally fertile. It may be contracted (solid carpel) or expanded (pseudo-valve carpel).

Though based very largely on the number and relationship of the vascular strands in the flower, it is claimed that the principles outlined "dispose of many morphological fictions, including hypothetical splittings and unions, hypothetical suppressed whorls, 'commissural' stigmas, 'false' partitions, 'free central' placentation and epigyny, as traditionally interpreted, while 'parietal' and 'axile' placentation and 'septicidal' dehiscence now have an altered significance. They provide an explanation of obdiplostemony, various forms of fruit dehiscence, and many other hitherto unexplained features".

There is no doubt that, considering the evidence as a whole, Miss Saunders has presented a strong case. It is probable that not all her interpretations will be accepted by future investigators; but they will have to be examined from the point of view of the evidence she has provided, even if other viewpoints be also considered valid. The evidence is particularly strong in the *Rhœadales* (including the *Cruciferæ*) and in the *Liliaceæ*. Some of the families in which it is probably more difficult to provide an acceptable interpretation of the structure of the gynoecium on the basis of carpel polymorphism, such as the *Leguminosæ*, are not included in this volume.

W. B. T.

Nauka Polska:

jej Potrzeby, Organizacja i Rozwój. (Science and Letters in Poland: their Needs, Organization and Progress.) Tom (Vol.) 22. Pp. ix + 433. (Warszawa: Kasy Imienia Mianowskiego, 1937.)

VOL. 22 of "Nauka Polska", an annual publication edited by Prof. S. Michalski and issued by the Mianowski Institute for promoting Science and Letters in Poland, is devoted largely to a series of papers on the influence of science upon human culture and progress. Among several noteworthy contributions is one by Prof. S. Ossowski, who deals with the influence of the personal opinions of the man of science on researches in the domain of the social sciences. He goes on to examine the effect that personal political and social convictions can have upon the course of a research worker's investigations in such subjects as sociology, political economy and anthropology, that is, in sciences directly contributing to progress in social life.

The influence of physics upon the development of modern civilization is the theme of a contribution from Prof. S. Szczeniowski, who endeavours to show how the theories of pure physics and the exact sciences have moulded opinion with regard to modern conceptions of the universe. Another interesting memoir in this issue of "Nauka Polska" is that by Mme. Danilewicz, who wishes to direct attention to the scientific work conducted between 1805 and 1831 at the former lycée of Krzemieniec in south-east Poland (Volhynia). The concerted attempt of an enthusiastic group of specialists in physics, chemistry, mineralogy and botany to create a local interest in the flora and natural resources of this district made a most promising beginning, but was afterwards suppressed for political reasons.

In the notes referring to scientific events in Poland and abroad there is a brief account of the British Association meeting at Blackpool, and reference is also made to the activities of the Research Co-ordination Committee.

P E P (Political and Economic Planning)

Report on International Trade: a Survey of Problems affecting the Expansion of International Trade, with Proposals for the Development of British Commercial Policy and Export Mechanism. Pp. vii + 302. (London: Political and Economic Planning, 1937.) Paper boards, 8*s*. 6*d*. net; cloth, 12*s*. 6*d*. net.

THE group of industrialists, distributors, local government officers, university teachers and others who have produced this comprehensive monograph claim allegiance to no political party and are concerned solely with the problems of social and economic reconstruction. It is a lengthy report and contains a mass of statistical and other matter, bearing on the mechanism, finance and politics of international trade. The writers conclude that the idea of sweeping away international trade barriers is impracticable and is being replaced by organized exchange between nations, which, however, should be more constructively planned. The report discusses at length such constructive measures by taking into account not merely economic needs but also politics, psychology, transfer difficulties and other relevant factors. Within the policy of the State there should be scope for the initiative of individual traders, especially in co-operative steps. International trade will probably become permanently a smaller proportion of total trade, and will certainly not return to past conditions; but on new and constructive lines there should be a measure of revival. Finally, it may be noted that the report examines frankly the role played in present trade by the economics of war.

Physiology in Health and Disease

By Prof. Carl J. Wiggers. Second edition, thoroughly revised. Pp. 1124. (London: Henry Kimpton, 1937.) 42*s*. net.

THE second edition of Prof. Wiggers' book follows the first after an interval of only two years. Special emphasis has been laid on subjects of clinical importance and the book is really a general textbook of clinical science. Chapters are devoted to such subjects as œdema, sleep, acidosis, peripheral vascular disorders, blood-pressure, valvular lesions, fever and diet. The section dealing with the circulation is particularly detailed.

The book covers much the same ground as Samson Wright's "Applied Physiology"; but it is about 35 per cent larger. No one man could speak with the authority of detailed knowledge over so wide a field, and the judgments of this book sometimes appear superficial. Its main value lies in the fact that it contains a very large number of references to original work and to detailed reviews. It should be useful to students and to those who seek access to literature dealing with subjects outside their own speciality. Prof. Wiggers is a physiologist, and his book will probably be more admired by physiologists than by clinicians.

The Physics of Electron Tubes

By Dr. L. R. Koller. (International Series in Physics.) Second edition. Pp. xvii + 234. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18*s*.

THE first (1933) edition of this book has already been favourably reviewed in NATURE (**133**, 968; 1934). The present second edition has been slightly enlarged, especially by the addition of short treatments of such topics as electron optics, secondary emission multipliers, "ignitrons" and positive ion emission.

The title of the book would be more appropriately "Introduction to the Physics of Electronic Devices", as it deals within its relatively short space not only with 'electron' tubes, that is, hard valves and photocells, but also includes gas-filled relays and even two chapters on photo-conductivity and photo-voltaic cells. The treatment is clear, bringing out the essential points. Intricate mathematics has been avoided by stating in such cases finished results; however, Richardson and Schottky's equation and the 3/2 power law have been derived in a special appendix.

Very useful for the beginner is a collection of problems (with solutions) and with the aid of a good list of references added to each chapter, he will be able to find his way to more detailed study of the subject. A. B.

Ammonolatry: The Life Element*

By Prof. Henry E. Armstrong, F.R.S.

(To a muted, musical undercurrent reminiscent of Aïda, in face of a moving, desert panorama with camels.)

FOR several months, while I have been confined to my room, I have had before me two unusual and remarkable books which are of special interest to me, at a time when we have to admit that far more consideration must be given to the manner in which chemists are trained. The books are E. C. Franklin's "Nitrogen System of Compounds" and N. V. Sidgwick's "Organic Chemistry of Nitrogen", in both of which I have particular reason to be interested.

About thirty years ago, soon after the great San Francisco earthquake (1906), I visited Leland Stanford University at Palo Alto. The founder was doing penance: he had been tossed from his pedestal and was standing upside down, with his head through the stone pavement: I believe he was ultimately restored to righteousness without a feature injured. Chemistry was well on its feet. The professor, Edward Curtis Franklin, was at an early stage in the inquiry, now so associated with his name and school, into the properties of liquid ammonia in comparison with those of water, especially as an electrolytic solvent: though boiling at − 33·35°, it comes close to water in activity. Liquid ammonia was being brought into use at that time as a refrigerating agent, and Franklin had command of the technical product.

It may be mentioned here in parenthesis that Gore in his earlier work on the subject (1872–73) was forced to prepare the liquid separately for each experiment, by heating ammoniated calcium chloride in the tube containing the substance to be tested. He tested the solubility of more than five hundred substances. He had great difficulty in securing support for his work—in those prehistoric days it was considered to be of little interest. He made a similar study of liquid hydrogen fluoride, and all but isolated fluorine. Few are left to remember his persistent pioneering efforts in advocacy of pure research, for which he made a great personal sacrifice: unfortunately, he was not original. I had the privilege of being made his confidant and always regretted that he had so little encouragement. We were then near to the renaissance period, but so low was the ebb of curiosity that Frankland, Vernon Harcourt and others were suggesting that a list of subjects for research should be prepared. Actually the main cause of activity was not Kekulé's benzene formula but the discovery by Kolbe and others, after the 1870 war, that research work could be made of commercial value. The poor professor disappeared but academic training began to lose its value; now, after a second war, in Germany, freedom of thought is gone. She may have gained much commercially but she has sold her scientific soul. Our task is to make the same change impossible here: it is already set in, largely through the influence of commercialism.

Franklin's reason for entering on the inquiry is stated by him as follows:

> "In the autumn of 1896, Hamilton P. Cady, then an undergraduate, was working at the regulation course in quantitative analysis. Observing after a time that the young man was becoming bored with the task, the writer, at the time giving instruction in analytical chemistry, proposed to him that he prepare several of the cobaltamine salts and confirm the composition of one or two of them by analysis. Some days later, with a beautifully crystallised specimen of one of these interesting salts in his hand, Cady stated that the ammonia in these and other salts containing ammonia must function in a manner very similar to that of water in salts with water of crystallisation. He suggested furthermore that liquid ammonia would probably be found to resemble water in its physical and chemical properties. As a direct consequence of Cady's suggestion has followed all the work done in this country on liquid ammonia."

Franklin died on February 13, 1937. We have to lament the loss of a colleague who could still regard chemistry as a practical subject but take notice of theory in general. His work on ammonia, already of no slight value, may some day rank high when the great problem of electrolytic conductivity is discussed with knowledge and without prejudice: as yet, it never has been. Franklin makes close comparison, compound by compound, of corresponding members of the oxygen and nitrogen systems. The ammonia work, however, is far from sufficiently described in his book. I had hoped the original papers would have been largely reproduced in readable form. If his friends were to provide a reprint it would be a pious act and a great boon to students. None the less, it is a most valuable conspectus.

Sidgwick's "Organic Chemistry of Nitrogen" is a book of very different type. Franklin would take us back to the worship of Jupiter Ammon, begun in the dry distillation of camel's dung. Sidgwick would have us 'resonate' to the latest doctrine of electro-valency. The first edition of his book was published in 1910; it was a positive thriller. Sidgwick gave me a copy, which I have always prized; this has rested on a shelf near to my elbow and has often been taken down; my hope that the new edition would have similar attraction is disappointed. Two Oxford fellows, T. W. J. Taylor and Wilson Baker, seem to have been mainly responsible for the new edition, but the names of a host of other helpers are given. Sidgwick only contributes seven pages of introduction and a page or two on *Chelate Orthonitrophenol derivatives*, which show that he is now devoted to the fashionable morganatic game of crab catching, an appropriate exercise for the Upper reaches of the Thames.

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* The proof of this article was corrected by Prof. Armstrong only a week before his death on July 13. The article represents, therefore, the final expression of the frank and critical views which he held upon the training of chemists and subjects of research. Whatever significance may be attached to these views, the fact that, while on his dying bed, he desired to make the two volumes mentioned in the article the subject of a contribution to NATURE, is a remarkable tribute to the active attention he gave to scientific subjects right unto the last. Prof. Sidgwick's book, to which Prof. Armstrong refers was reviewed in NATURE of July 3.—The Editor.

The plan remains what it was. The intention is said to have been to give an account of the simpler organic compounds and to discuss some of the interesting problems which these properties present, giving so far as possible adequate explanation of the necessary physical background. The authors have not the practical experience and critical judgment necessary to carry out their task in a way to make the book of practical value to students who would train to be chemists—of whom there are very few at Oxford. It is not a beginners' book and makes high demands upon previous knowledge, without explanation plunging the reader forthwith into technicalities known only to the specialist and impossible for the ordinary reader to understand. Though highly discursive and scrappy at times, necessarily a book written at such length contains much that is interesting, but no training in judicial method is to be gained from its use.

At least half of what is regarded as the most intellectual of our youth is attracted to the University of Oxford; this element is all but absolutely classical in its outlook. Oxford needs medicine of a very different order from that represented in Sidgwick's book: medicine that will make it a school of practice in chemistry, not one of elocution. The University is receiving large funds but its traditions are such that it does not attempt to train men to be efficient and effective laboratory workers. It has grown up upon words and lives upon them. The Oxford way is to enforce knowledge of what is done as a preliminary to doing work—but you cannot learn a subject like chemistry without *doing* from the beginning and all the time. The book will suit Oxford youth able to memorize the purple patches and offer them up on the examination altar, hoping on leaving the Examination Schools to find an emissary of I.C.I. awaiting their return with the prized admission card to an assured haven of research. They, however, will have had little or no effective training in chemistry but only parrot instruction in structural formulæ.

In the first line of the brief introduction to the book the author at once plunges into the valency problem with full measure of 'noughts and crosses', mainly dealing with *Resonance*, blankly asserting that:

> "The conception is the most important development which structural chemistry has had since it was extended to three dimensions by van 't Hoff in 1874. It is a result of the application of wave mechanics and could not have been deduced from classical dynamics; but its essential conclusions can be stated very simply. If a molecule can have two or more different structures in the ordinary organic sense of the term, then under certain conditions its actual state is neither one nor the other but something intermediate between the two, which partakes to some extent of the properties of both but cannot be expressed in the usual structural symbols. The molecule is then said to exhibit resonance and to be a resonance-hybrid of the two or more structures.

This is a declaration which I hesitate to endorse. In his recently delivered presidential address to the Chemical Society (*J. Chem. Soc.*, April), our would-be trumpeter of nitrogen speaks with even greater modesty and exceptional clearness. We are there told that it was a product of the obscure doctrine of wave mechanism.

> "The general conclusions of the theory of resonance are of great practical importance, especially to the organic chemist. But it is not to be expected that more than a very few organic chemists will have either the time or the ability to master these mathematical operations. It is therefore obviously our duty to express—or to induce the wave-mechanisians to express—the results in the simplest terms that are possible and this can really be done quite easily. The use of the technical language of wave mechanics for this purpose is quite unnecessary and in fact misleading, for it makes the non-mathematical reader think that as he can't understand the language he can't understand the conclusions either, which is quite untrue; and not uncommonly, I think, it leads the non-mathematical writer to believe that if he knows the technical terms he must understand their meaning, which is by no means always the case."

I have known strange things said in chemistry but have never before been quite so stood upon my head.

Passing to the examples given, with carbon dioxide we have the three formulæ:

$$\mathrm{O{=}C{=}O} \qquad \mathrm{O\underset{=}{\rightarrow}C\rightarrow O} \qquad \mathrm{O\leftarrow C\underset{=}{\leftarrow}O}$$

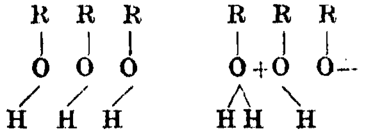
"According to the theory of resonance, since all these formulæ represent linear molecules and should have about the same stability or heat of formation, resonance must occur and the actual state of the molecule will be something intermediate between

> them which we call a resonance hybrid, which will have a greater stability and heat of formation and a rather smaller distance between the atoms, than correspond to any one of the formulæ. Experiment shows that this is so. Further, since the last two formulæ are really the same, they must be represented to the same extent in the actual state of the hybrid, which therefore should be non-polar, as it is found to be."

According to this, resonance would seem to be a state of suspended animation in a molecular system with a shortened waist. Is not this "Much Ado about Nothing"? In what way it is an advance upon van 't Hoff is not clear. Kolbe was angered that van 't Hoff should introduce metaphysics into chemistry—what he would have said to Sidgwick passes expression. I am open to the retort, I know, that van 't Hoff was justified, but he had a solid model to build upon.

One of the more important applications of the conception of resonance is to the explanation of the power of hydrogen to serve as a bivalent link. There is no doubt, says Sidgwick, that a hydrogen atom is able to hold two oxygen atoms together. To me the evidence is entirely inadequate, nor is his present argument impressive.

> "The crystallographers," he says, "have actually measured the length of this O-H O link (about 2·5 A) which they call the hydrogen link but the idea which formerly prevailed that this link, like co-ordinate links in general, was due to the hydrogen taking up two more shared electrons (so that it had four in all) is now known to be impossible, since a hydrogen atom cannot hold four electrons with sufficient firmness. The only alternative explanation is that we have resonance between the ordinary form and one in which there is an oxonium cation and an R-O anion:"



Truly a soul-saving set of symbols. Faint praise; scarcely hanging evidence. The nonchalance with which the inability to carry more electrons is treated and a new hypothesis at once found is amusing. Still better follows:

> "The most extensive group of organic substances whose behaviour is determined by resonance is that of the aromatic compounds. It was recognised from the beginning that the two difficulties in the way of Kekulé's formula for benzene are, first, that we should expect two *ortho* di-derivatives; secondly, that benzene should have the reactivity of an ethylene derivative, whereas in fact it behaves almost always as a saturated compound. The conception of resonance removes both of these objections at once: the first because we assume the state of the ortho-compound to be permanently half-way between the two formulæ and the second on account of the increased stability which the resonance must produce. The last point can be determined experimentally from the heats of formation."

Such a statement cannot be taken seriously and it suggests insufficient historical and practical knowledge of the subject. I was one of the earliest workers with benzene, beginning in 1868. We never treated Kekulé's formulæ seriously—except for the purpose of registering the assumed disposal of substituent affinities: apart from the few who 'hammered' the idea for their own purposes, we thought of the two forms as present, if at all, in balanced proportions. The benzene symbol was used, not as a structural expression but as a convention in expressing interactions. We soon learnt that benzene had not the reactivity of an ethylene derivative. This led me to introduce the Centric formula.

The X-ray workers in course of time may help us out of our difficulty, but they are very slow. What are the forms of carbon: what of the form of that in benzene? The paraffins are the only hydrocarbons containing diamond carbon. We know scarcely anything of paraffinoids generally. Edgar's work with heptanes shows that isomerides differ greatly, presumably owing to shape and difficulty of packing. Rumour goes that a paraffin has been made which won't pack and therefore declines to solidify—too resonant, I suppose.

Benzene, we know, contains a second form of carbon, which I would call *ethenoid*. The centres of the atoms are in a plane, not zigzagged, the distance between them less than in diamond carbon. What is hexamethylene—benzene with six "electronic" pits filled in? It is little but a copy of benzene in appearance and properties.

During my lifetime the theory of valency has been developed from remarkably simple beginnings. When I began with Frankland in 1865, I heard his first course of lectures at the Royal College of Chemistry, published in his well-known book. He adopted Crum Brown's Graphite formulæ, behind which lay the tetrahedral conception. Carbon was a wooden ball with four holes in it. He had assimilated Kekulé's formulæ. I hold a paged proof of the later edition of his book in which he has written in all these. The original struggle between Kekulé and Frankland was over a fixed maximum of valency, that need not all be exercised but partly in abeyance. Kekulé as a joke copied Munchausen's method of shooting ducks on a ramrod.

Graphite is the puzzle—it seems to combine the two forms of carbon. This comes out very clearly in the model (Fig. 1).

The crystal is shown to consist of flat phenoid rings in parallel planes, 3–4 A. apart, more than double the distance between two atoms in the plane ring. When oxidized, oxygen atoms seem to penetrate directly into the wide space between layers and this plane is porous to other agents also. I seem to see the atoms as a bird-like structure, with unequal wings, one paraffinoid about double the length of the other one: the other, the shorter, ethenoid as in benzene.

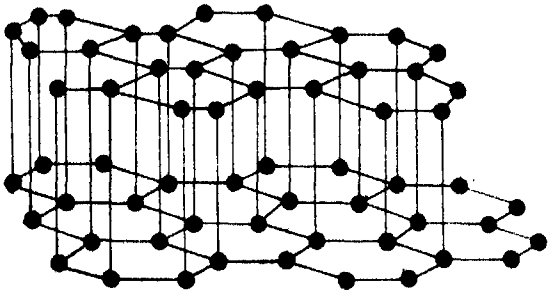
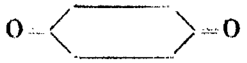


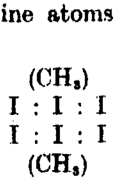
Fig. 1.
MODEL OF GRAPHITE. FROM *Chemistry and Industry*, AUG. 14, 1936.

Two forms of valency ultimately emerged—which acquired precision only when one was seen to be fixed by the *Electronic Charge*; the other being that which Pickering and I termed *Residual* Affinity. I discussed this very fully in March 1886 in the *Proceedings of the Royal Society* in a paper on electrolytic conduction in relation to molecular composition, valency and the nature of chemical change. In the previous year (March 1885) I dealt fully with the conditions of chemical change, a subject entirely left out of account in modern times. Then in 1888 I discussed the origin of colour and formulated the explanation since known as the Quinonoid Hypothesis (*Chem. Soc. Proc.*, March 1888).

I postulated a triple unsymmetrical absorbing system, such as that in quinone.



I soon discarded mere material absorption and taking iodoform as type, assumed that the residual affinities of the iodine atoms came into play as absorbent centres.



$$\begin{array}{c}(CH_3)\\ I : I : I\\ I : I : I\\ (CH_3)\end{array}$$

In fact, I became dotty at an early stage in my career. I was specially fascinated at the time by fluorescent compounds and triphenyl methane derivatives. My colour hypothesis is applicable to all ethenoid properties, and what I set out to explain fifty years ago is little short of what Sidgwick would now explain. I doubt if there be much difference between us, but having read the classics early, I have always been held up by the caution:

> What's the use of Mercators
> Tropics, Zones and Equators.
> They are merely conventional signs.

Kekulé wrote an imperishable sign upon the fair face of our science when he introduced the simple hexagon. This expresses the one fact that is established—that six carbon atoms form a symmetrical complex, providing a convention which permits us to register and discuss isomerism in particular.

The colour of meta-compounds, I early asserted, was merely a case of the absorbent centres being in part formed between contiguous molecules—that is to say, extramolecular; whilst in para- and ortho-quinones it is within the molecule, intramolecular.

Whatever resonance hybrids may be, do or suffer, they have little practical significance. To take up time in indoctrinating students at the university with such vagaries is not justifiable. At the moment we are in sorest need of chemists—it were time that the University Grants Committee or similar body intervened to secure rational, practical training for those few who will give serious attention to the several subjects to be studied.

Students have to be taught according to their dispositions. The biological type is very rare; no greater perversion of the type exists than the ordinary biochemist, who is so-called because he works with material of living origin. The flag can be carried by very few. Mathematics beyond more than a very elementary stage is also without appeal to the chemist proper: the mathematician is a machine—prepared to let it be granted and act accordingly. The chemist should be inspired with feeling and only ask for truth and substance; he should go straight to Nature. Of course, the majority who inflict themselves upon the natural sciences are just machines. The only teacher is experience.

The fact is, we forget how much that is taught as chemistry is mere convention. The hands-across, down-the-middle, business of "The Lancers". The "bridged-ring" is just Huck Finn, let-on stuff, yet the majority swallow it whole. Kekulé so demoralized chemists by his Ring that they have no hesitation even in giving it a handle, a bridge. Benzene must be a solid block of atoms—in so far as atoms made of electrons can be solid.

For a book on the chemistry of nitrogen, the most wonderful of all the elements in forming character—the determining element of life—to be of outstanding value, it must make manifest the sympathy which only long experience in the laboratory begets and inculcate habits of scientific thought that will be of service to the student who desires to be a working chemist or to teach the subject in our schools. It is possible to reach the standard of knowledge required for a 'first' without acquiring these habits; this would not matter were *it not that Firsts go into schools and stagnate*. The failure of Firsts in the schools is the outstanding calamity of the costly attempt to introduce scientific training into education made during the past seventy years.

Chemistry at present is a sick man—"mostly conventional signs". Something less Snarkian is needed than "*to measure the value of an idea in* terms of incomprehensibility."

Darwin in Uruguay

By Dr. J. D. Falconer

H.M.S. *BEAGLE*, under the command of Capt. Fitzroy, sailed from Rio de Janeiro on July 5, 1832, for the Plata and anchored at Montevideo on July 26. For more than a year the ship was employed in surveying the extreme southern and eastern coasts of South America. The Plata was used as a base and to it from time to time the *Beagle* returned. Thus Charles Darwin, the naturalist aboard, had several opportunities of making closer acquaintance with the northern shores of the estuary and more particularly with the natural history and geology of the Banda Oriental, by which name the Republic of Uruguay, to the east of the Río Uruguay, was at that time known.

During the nineteenth century, Maldonado Bay at the mouth of the estuary was a favourite anchorage for ocean vessels. A strip of sand lined the margin of the bay and provided a playground for the men of the sea. In 1832 Darwin spent ten weeks at Maldonado and procured "a nearly perfect collection of the animals, birds, and reptiles" of the vicinity. He described Maldonado as "a most quiet, forlorn, little town: . . . separated from the river by a band of sand hillocks about a mile broad: it is surrounded on all other sides by an open slightly undulating country, covered by one uniform layer of fine green turf, on which countless herds of cattle, sheep, and horses graze. . . . The scenery is very uninteresting; there is scarcely a house, an enclosed piece of ground, or even a tree, to give it an air of cheerfulness"[1]. To this day Maldonado retains its secluded aspect, being overshadowed by the modern resort of Punta del Este on the eastern horn of the bay. The sands, however, are now grassed and treed over, the pastures fenced and decorated with plantations, rail and road communications developed and frequented, and the landscape dotted with houses and gardens and cultivated fields.

It was at Maldonado that Darwin's attention was directed to the occurrence of vitrified siliceous tubes (fulgurites) in the sand dunes, similar to, but shorter than, those described from Drigg in Cumberland in 1814[2]. These tubes, believed to be formed by lightning, are still found at Maldonado but less frequently than before, on account of the cover of vegetation.

Between Maldonado and Montevideo along the northern bank of the Plata, Darwin again remarked upon the absence of trees and the uninteresting character of the grassy plains, decorated only by occasional hummocks of granitic rock. He concluded somewhat hastily that in spite of abundant rain and a favourable climate "herbaceous plants, instead of trees, were created to occupy that wide area"[3]. However this may be, within the last hundred years there has been much successful afforestation, and along the shores of the estuary and in many parts of the interior the aspect of the country has been completely changed.

In November 1833, Darwin made an excursion into the south-western corner of Uruguay, from Montevideo to Colonia Sacrimiento, and thence to Mercedes on the Río Negro. By this time, after some experience of the pampas of Argentina, his opinions of the scenery and amenities of the Banda Oriental had undergone a change. He wrote: "I find that I look at this province with very different eyes, from what I did upon my first arrival. I recollect I then thought it singularly level; but now, after galloping over the Pampas, my only surprise is, what could have induced me ever to have called it level. The country is a series of undulations, in themselves perhaps not absolutely great, but as compared to the plains of St. Fe, real mountains. From these inequalities there is an abundance of rivulets, and the turf is green and luxuriant"[4].

On this expedition, Darwin visited the Arroyo de las Vivoras and Punta Gorda on the left bank of the Río Uruguay. From Mercedes he rode to the Sierra del Pedro Flaco, 20 miles up the Río Negro, and examined the natural sections in the cliffs of Perika. He returned in a direct line across country to Montevideo, having been absent from the port for fourteen days. The *Beagle* sailed from the Plata for the last time on December 6, 1833.

Prof. Karl Walther, of Montevideo, has been at some pains to identify the exact spot on the bank of the Río Negro that Darwin visited, and he has come to the conclusion that the "cliffs of Perika" are those of the Cerro de los Claveles at the confluence of the Arroyo Perico Flaco and the Río Negro[5]. The streams have here incised their channels below the level of the plains and the so-called Cerro is simply a projecting bluff overlooking the river. This locality has been marked by Prof. Walther by the erection of a stone in commemoration of Darwin's visit in 1833. There is, however, a considerable difference between the height of the river-bank, 30–35 m. according to Walther[5], and that of the cliffs of Perika, about 50 ft. according to Darwin[6]: also in the composition of the lower part of the cliffs as recorded respectively by Walther and Darwin. It is thus permissible to doubt whether the actual section described by Darwin has yet been recognized. It is certain, however, that the river bank in this locality was Darwin's "farthest north" in Uruguay, and it was an admirable thought and a graceful tribute on the part of Prof. Walther to mark out a "Rincón Darwin" and to give the name of "Darwin Cliff" to the Cerro de los Claveles in recognition of "the importance of the geological observations initiated by the great British scientist"[5].

Some play has been made of recent years in local scientific circles over the alleged polemic between Darwin and D'Orbigny about the occurrence at Punta Gorda beneath well-defined Tertiary strata (Entrerriano) "in the vertical cliff, nearly on a level with the river" of "a bed of red mud absolutely like the Pampean deposit, with numerous often large concretions of perfectly characterized white, compact tosca-rock"[7]. D'Orbigny, who had preceded Darwin in South America and to whom Darwin was much indebted for examining and naming his molluscan fossils, had not seen the section at Punta Gorda during his sojourn in Uruguay and Argentina in the years 1826–29, but he had stated that he was unwilling to believe that beds of the same nature with the Pampean formation ever underlie the ancient marine Tertiary strata[8]. He maintained that there could be no analogy between the lower beds at Punta Gorda, which were of marine origin, and the Pampean clay, which was of quite a different character "déposée dans un laps de temps très-court, comme le résultat d'une grande commotion terrestre"[9]. Darwin steadily refused to accept this hypothesis and insisted that "from whatever source and through whatever means the great Pampean *formation originated*, we *here have* unequivocal evidence of a similar action at a period before that of the deposition of the marine Tertiary strata"[10].

The incident left an unpleasant flavour which has not yet been dispelled. Difficulties of investigation and comparison, of translation and re-translation, keep the controversy alive, while almost every author who visits the locality provides a different interpretation. Kraglievich of Buenos Aires, now deceased, who knew the red mud of Punta Gorda, said that "its nature is not entirely equal to that of the true Pampean of Argentina, . . . being much more similar to the clay and loessitic sandstone of Uruguay"[11]. Windhausen, also deceased, considered this sufficiently confirmative of Darwin's observation of a continental layer beneath the marine Tertiary beds[12]. Prof. Walther supports D'Orbigny, and represents Darwin as having fallen into error[5]. He admits that at first sight the character of the rock at Punta Gorda is "loessoid or similar to Pampean clay"[13], but asserts that there is a distinct petrographical difference between the two deposits. This has been investigated by Frengelli[14], who states that under the microscope the Punta Gorda clay is almost entirely composed of particles of volcanic glass with grains of sand scantily accessory, while in the Pampean clays the volcanic material is accessory to fine sand and silt. Thus it would appear that volcanic dust which falls on the pampas at the present day fell sometimes much more abundantly in the same region in past ages, and that there is accordingly every justification for Darwin's suggestion of the recurrence of similar conditions during the accumulation of the great Pampean formation.

While, therefore, it is clear that in respect of Punta Gorda, Darwin cannot reasonably be accused of any serious error of observation, those of us who know something of the country he traversed will readily agree with Prof. Walther in admiring the fact that, in a hurried journey of fourteen days, he was able to recognize certain details of geological structure the significance and importance of which are still being debated by lesser minds after the lapse of a hundred years.

[1] "Narrative", 3, 45, 46 (1839).
[2] *Geol. Trans.*, 2, 528 (1814).
[3] "Narrative", 3, 53 (1839).
[4] "Narrative", 3, 169 (1839).
[5] *Rev. Fac. Agr. Montevideo*, No. 8 (1933).
[6] "Geology", 3, 94 (1846).
[7] "Geology", 3, 92 (1846).
[8] "Geology", 3, 93 (1846).
[9] "Voyage", 27, 73 (1842).
[10] "Geology", 3, 94 (1846).
[11] *Rev. Soc. Am. Arg. Montevideo*, 2, 33 (1928).
[12] *Geologia Argentina*, 2, 476 (1931).
[13] *Bol. I.G.P. Montevideo*, No. 13, 33 (1930).
[14] *Bol. I.G.P. Montevideo*, No. 12, 26 (1930).

Obituary Notices

Prof. H. E. Armstrong, F.R.S.

HENRY EDWARD ARMSTRONG, whose death on July 13 in his ninetieth year we regret to announce, was born on May 6, 1848, in Lewisham, where he lived all his life. Of the influences during his early youth which inclined him to chemistry, little is known, but when he left Colfe's Grammar School at Lewisham his father, acting on the advice of an engineering friend, allowed him to become a student at the Royal College of Chemistry, Oxford Street, in the summer term of 1865, actually Hofmann's last term before his departure for Berlin. Chemistry was the only subject taught, but the College was affiliated to the Royal School of Mines, then housed in Jermyn Street. A free lance, he attended such courses at the two institutions as he thought fit, including among them those given by Tyndall, Huxley and Ramsay, being also for some unexplained reason an almost regular attendant on Saturdays in the operating theatre of St. Bartholomew's Hospital. This roving quest came to an end when Frankland, who had followed Hofmann as professor and, towards the close of 1866, had been appointed with two other members a Royal Commission to inquire into the pollution of rivers in Great Britain, took him into the private laboratory, where together they developed the combustion *in vacuo* method of water analysis, which played so important a part in the campaign for ensuring the safety of the domestic water supplies of the country.

In October 1868, while yet young and impressionable, Armstrong went to Leipzig to work under Kolbe, an inspiring teacher, but remembered also as an unsparing and provocative critic. Graduating Ph.D. after five semesters, he returned to work with Matthiessen on alkaloids at St. Bartholomew's Hospital Medical School and, during the next twelve years, had charge of the chemistry classes for medical students preparing for the London degree; his appointment as professor of chemistry at the London Institution, Finsbury Square, followed a few months later. An earlier occupant of the chair had been Sir George Grove, inventor of the unpolarizable Grove cell and the hydrogen-oxygen gas battery: Armstrong's interest in the general problem of chemical interchange, and particularly of the part played by the depolarizer, can be dated from his discovery of specimens of the battery in the Institution's laboratory and the purchase of a copy of Grove's memoirs.

Armstrong's next appointment was that of professor of chemistry in the City and Guilds of London Institute for the Advancement of Technical Education, founded in 1878, but until the Finsbury Technical College was ready for occupation in 1883, the work of his department had to be carried on during four years in temporary quarters at the Cowper Street Schools, Finsbury. A year later he was translated to the newly erected City and Guilds College, South Kensington, where a novel type of institution came into being, self-governed academically by its four professors—chemistry, engineering, mathematics and physics—and independent of external examiners, which rapidly grew to be recognized as a great professional school of engineering. But in 1911, when the City and Guilds College by incorporation became the engineering section of the Imperial College of Science and Technology, its chemistry and mathematics departments were closed down, although provision was made for chemistry diploma students to finish their course under Armstrong's supervision—with its completion, chemistry ceased to be taught in the City and Guilds College, and the last of the laboratories of the department was dismantled in 1914.

The submergence of the chemistry department involved also the closing down of its crystallography laboratory, the only one in Britain, after an existence of rather more than a quarter of a century. Convinced that the most certain method of identifying a substance was to be found in its crystalline form, Armstrong in 1886 determined that, as an essential part of their training, diploma students in chemistry should measure any new crystalline substances they might prepare which were suitable for the purpose. To this end a course of laboratory instruction was arranged by Mr. H. A. (now Sir Henry) Miers, and under his direction and that of Pope and of Lowry who succeeded him, a wealth of material was accumulated, which led to the publication by Armstrong, conjointly with Colgate and Rodd, of a series of papers under the title "Morphological Studies of Benzene Derivatives" in the *Proceedings of the Royal Society* during 1910–14.

Thus ended an interesting and—if account be taken of the careers of students trained by its methods—a successful experiment in teaching chemistry on scientific, if unorthodox, lines. For Armstrong, such an ending was unrelieved tragedy. Thereafter, although a small suite of laboratories was placed at his service in the Royal College of Science building, it was no longer as an investigator but by controversy that his work as missionary for the propagation of the truth as he conceived it was carried on.

During the tenure of his chair at the London Institution, Armstrong maintained a steady output of research, but it was in an unexpected role that he first directed attention to himself. While working with medical students, but without previous training as a teacher, he—to use his own words—taught himself how to teach them chemistry and, aided by that effort, developed the system which became known as the heuristic method of teaching science experimentally in schools, in the advocacy of which, as opposed to the didactic method then followed, he never spared himself—or others—from the time he first championed the cause at the International

Conference on Education, convened in connexion with the Health Exhibition of 1884. In the paper submitted to the Conference, he outlined a constructive plan for training pupils "to observe and think and act with clearly defined purpose, the work being carried out with common materials and in relation to common phenomena". This scheme was elaborated in his contribution to the "Special Reports on Education" published by the Board of Education in 1888, and in the second report of the British Association Committee appointed in the same year "to inquire into and report on the methods of teaching chemistry in schools", whilst criticism of schoolmasters figured prominently in his addresses as president to the Chemical Society in 1894 and later to the Chemistry and Education Sections of the British Association. The heuristic method on the scale that Armstrong conceived it is dead: its fate could not be otherwise under an examination system —intensified since the widespread adoption of the School Certificate—which does not distinguish between the school and the academic outlook on science as a mental discipline.

Prior to the move to South Kensington, Armstrong had three major problems in chemistry continually in mind: the confusion about methods of determining constitution in the naphthalene series; the perplexing reactivities of camphor which served only to show the inadequacy of any formula for the substance based on the benzene model; and the mechanism of chemical change. Before his contribution to the elucidation of each is reviewed briefly, it should be mentioned that, as the College catered chiefly for engineers, the number of diploma students in chemistry was always small. Nevertheless, it was not long before the department as a school of research in organic chemistry attracted advanced workers from other institutions, doubtless in appreciation of Armstrong's pervading influence and a wise choice of members of his staff. He was constantly in the laboratory, his technical skill was always available when difficulties in manipulation arose, and his advice, encouragement, criticism and retentive memory never failed those who could benefit by them. If a measure of his stature as professor be desired, it may perhaps be gauged by the fact that, of those who worked under him as colleagues or pupils, not a few have achieved marked success in industry, whilst of the others six either hold or have held university chairs and seven became fellows of the Royal Society.

The naphthalene research, resumed in 1886, in which Davis, Rossiter, Lapworth and Wynne took part, was concerned with the bromination, nitration and sulphonation of the hydrocarbon and of its halogen and hydroxy derivatives and included a study of the mechanism of nitration; the investigation of many cases among sulphonic acids of the transference ('isomeric change') of the sulphonic group from one position to another within the molecule; and the preparation and identification of the complete number of di- and tri-chloronaphthalenes theoretically possible —ten and fourteen respectively—by reference to which the structure of any di- or tri-derivative of the hydrocarbon could be ascertained beyond doubt. Incidentally, it may be mentioned that Armstrong's series of papers embodying evidence for his view that carbon compounds exhibiting colour are quinone-like in structure belongs also to this period.

Towards the solution of the problem of the constitution of camphor from the analytical side, Armstrong and his collaborators made many important contributions. With Miller in the early 'eighties, he identified no fewer than four C_{10} homologues of benzene in the products of the action of sulphuric acid and other dehydrating agents on the substance. Then he and Kipping, who joined the staff in 1891, investigated 'camphren', an oxygenated product of the interaction with the acid—an inquiry which led Kipping jointly with Pope to discover how to sulphonate, rather than to dehydrate, camphor and to unravel the intricate isomerism of the camphorsulphonic acids thus obtained. Important, too, was the identification of the three positions in which substitution occurs in the camphor molecule: this followed from the investigations of Kipping and Pope for the π-derivatives and of Armstrong and Lowry for the α- and β-derivatives. It was while studying the nitration of dibromocamphor at the College that Forster's interest in camphor chemistry was kindled and there, too, that Lowry's study of the mutarotation of nitrocamphor in various solvents proved that 'isomeric change' is not spontaneous but dependent on the presence of a catalyst.

Armstrong's unwavering advocacy of Faraday's view that "ordinary chemical actions . . . are themselves electrical" led him to define "chemical action as reversed electrolysis". The arguments by which this thesis was defended are to be found in the presidential addresses to the Chemistry Section of the British Association at Aberdeen in 1885 and Winnipeg in 1910; the presidential address to the Chemical Society in 1895; and in frequent contributions to ephemeral literature during the last half century. From first to last he never ceased to urge the view that solution is in effect a manifestation of chemical activity, the production of an electrolyte in aqueous solution being dependent on the combination of solvent and solute. Hence the prolonged controversy with Arrhenius (and Ostwald) whose theory of electrolytic dissociation in solution he regarded not only as unnecessary but erroneous—to be denounced with almost religious fervour as a chemical heresy. Although the Arrhenius conception has lent itself to modification, predicating among its later developments association of the *ions* of the solute with the solvent, and in its primitive form is now mainly of historical interest, the hydrate theory of solution has not emerged from the merely qualitative stage and involves too many unverifiable assumptions to make headway. Armstrong's experimental contribution to the discussion, in which Caldwell, Eyre, Worley and others assisted, is to be found in the thirty-two papers published during the period 1906–14 in the *Proceedings of the Royal Society* under the title "Processes Operative in Solution", the sixth of which gave, in 1908, the most complete statement of his theoretical views.

A few years earlier than, but parallel with, this inquiry into the nature of solution, Armstrong's interest in biological problems, never long in abeyance, led to an equally protracted study of the nature and mode of action of enzymes being undertaken under his guidance, about which, when it was begun, little exact information was available. In the first eight of the twenty-three papers, all of which save the first are to be found in the *Proceedings of the Royal Society*, E. F. Armstrong (Salters' Company's research fellow at the College, 1902–5) showed quantitatively that the action of sucroclastic enzymes as hydrolytic agents is controlled or retarded by the products to which they give rise and that from glucose by interaction with maltase, *iso*maltose, but with emulsin, maltose is synthesized. Later, the two Armstrongs with Horton isolated a β-glucase (prunase) both from the mixture of enzymes known as emulsin, and, more readily, from various species of *Prunus*, which was used by them to ascertain the distribution of cyanophoric glucosides in a variety of herbage plants and its variation with locality and season. Mention, too, must be made of the elder Armstrong's investigation of the activities of urease, linase and lipase—including the synthesis of fats by the aid of the last-named—carried out in conjunction with Caldwell, Eyre, Gosney and Horton among others which led to the conclusion that action takes place wholly at the surface of the colloidal particles of the enzyme in suspension—not between substances in solution—the enzyme having the double function of attracting the hydrolyte and of determining its hydrolysis. Not the least interesting of the series was a paper by the Armstrongs on the action of chloroform, toluene and similar substances in stimulating enzymic action in living structures which they suggest may lead to an understanding of the physiological function of the esters, terpenes and scents secreted by plants and of anæsthetics.

Of the many educational and agricultural bodies with which he was associated, two in particular gave Armstrong much pleasure: he was appointed a member of the Council of Almoners of Christ's Hospital in 1896 on the nomination of the Royal Society, and, after many years as deputy chairman of the Committee of Education, became its chairman in 1930, holding office until his health failed; and he represented the Chemical Society on the Lawes Agricultural Trust Committee at Rothamsted from its inception in 1889, becoming its vice-chairman in 1918 and its chairman so recently as last May. Frequently of late years in addresses and in articles from his pen, the national importance of pure (non-pasteurized) milk, natural foods and honest beer was urged as also the improvement of grass and other crops necessary for their production. His last public speech was made at a 'barley' meeting of farmers at Warminster in July 1936.

Fond of the open country and a frequent traveller abroad in middle life as Armstrong was, Borrowdale in spring and autumn became for many years his beloved holiday resort. Field geology was one of his hobbies: he was for many years a member of the Geologists' Association, and photographed the chalk from Yorkshire to Dorset to supply the illustrations for the monographs on this formation prepared by the late Dr. Rowe of Margate. Another was his garden, and in the unrivalled colours of flowers he found the utmost pleasure: the æsthetic side of his nature found its satisfaction, too, in other ways—he was an enthusiastic opera-goer and a discriminating lover of pictures. Let it be added that no account of his life would be complete without a tribute to the memory of his wife, whose serenity and comprehending sympathy during the fifty-eight years of their married life were to him boons ever gratefully acknowledged.

Armstrong was *doyen* of the Royal Society, having been elected to the fellowship in 1876; he had been a fellow of the Chemical Society since 1870, one of its honorary secretaries during eighteen years, and its president during two; LL.D. of St. Andrews; D.Sc. of Melbourne and Madrid; honorary liveryman of the Leathersellers' Company; Davy medallist of the Royal Society; Albert medallist of the Royal Society of Arts; Messel medallist of the Society of Chemical Industry; and Horace Brown medallist of the Institute of Brewing.

Temperamentally, Armstrong allowed feeling to influence his judgment to a degree unusual in an exponent of experimental science. Few of his speeches and writings were free from this intrusion: in his view, as expressed in the article "Chemistry" in the thirteenth edition of the "Encyclopaedia Britannica" (1926), "Chemistry however is an art as much as a science and the chemist is full of feeling which cannot be quantified". Essentially an individualist, he did not find it easy to co-operate with others even for causes that aroused his enthusiasm and, if "apostolic blows and knocks" were not forgotten in the advocacy of his views, an autobiographical note in a recent article (1932) is not without significance: " 'Somewhat arrogant and extreme perhaps in his denunciation'—the opinion passed by George Eliot on Savonarola in the proem to Romola—will probably be the criticism passed on me by my friends. The situation is saved by her remark 'But a *Frate predicatore*, who wanted to move the people, how could he be moderate?' " Nevertheless, those who knew only this side of Armstrong failed to recognize that these were but the defects of his qualities. Lacking his disinterestedness, his essential goodness of heart and his idealism, he could not have won and kept the good-humoured acceptance as an institution which became his in the post-War years. The attitude of mentor, the wounding criticism from a too facile pen: these need not be remembered now—rather we have to mourn the passing of a man whose devotion to chemistry, not least in its social implications, was the master passion of his life. W. P. W.

We regret to announce the following deaths:

Prof. Percy Gardner, emeritus professor of classical archæology in the University of Oxford, on July 17, aged ninety years.

The Marchese Marconi, on July 20, aged sixty-three years.

News and Views

Long Distance Air Record

THE Russian pilot, Colonel Michael Gromoff, with two companions, flying an Ant 25—1, landed at San Jacinto, California, on July 14—a flight estimated to be of about 6,625 miles from Moscow, over the North Pole which lasted 61 hours 7 minutes. The existing record of 5,675 miles, was held by the French airmen Codos and Rossi. The Soviet Government has been interested in this route, which follows practically a direct line across the North Pole. The pilot's log mentions the points Moscow, south-west Novaya Zemlya, North Pole, northern British Columbia, Oregon, San Francisco, and San Jacinto. So recently as last June, Chekaloff with two others on a similar machine flew over the same course, reaching Portland, Washington, a distance of 5,500 miles. The machine, also an Ant 25—1, was specially fitted for long-distance work, carrying extra fuel tanks and liquid oxygen, presumably for flying at considerable altitudes. The total loaded weight of the machine was 11½ tons, about 6 tons of which is stated to have been fuel for the flight.

ONE result of this flight, although possibly of a negative order, is the confirmation of the fact that the severe storms encountered, added to many hundreds of miles of ice-bound regions in which forced landings would be impossible, make it questionable as to whether such a route can ever be a commercial possibility, even though it may be the shortest distance from northern Europe to North America. Apart from this, such flights have an obvious interest to the Russian authorities, whose internal air transport and military defence problems over the long distances in northern Siberia, are of a very similar nature. Colonel Gromoff is a well-known Russian test pilot, who has been connected with the development of Russian aviation since about 1917. His name has been particularly associated with the principal Russian research station, the Moscow Central Aerodynamic Institute. It is interesting to remember that he broke a world record in 1934 with a continuous flight of 7,765 miles in a closed circuit.

Commercial Production of Oil from Coal

ON July 14, the House of Lords debated a Motion by Lord Mottistone that plant for obtaining oil from coal should be set up in Durham and South Wales in the interests both of national defence and increase of employment. Lord McGowan said that the experience of Imperial Chemical Industries, Ltd., has established the technical possibility of such processes but at capital and operating costs so high that the process, even with the assistance of existing protection, is not attractive to private capital. Success would have to depend not on private initiative, but on Government policy. The production of heavy oil for marine purposes from coal is at present uneconomical. The effect on employment ought not to be exaggerated. A plant capable of producing 150,000 tons of petrol annually provides work for 6,000 persons of whom 2,500 would be miners. Low-temperature carbonization and hydrogenation are complementary processes, and increased use of smokeless household fuels would promote both national security and national welfare. Hydrogenation processes, he emphasized, are a question of high national policy and beyond the purview of an ordinary limited liability company. Reference was made to the Fischer process and other methods of developing the use of coal. Lord Hutchinson, in reply, said the Government is awaiting the report of Lord Falmouth's Committee before deciding its policy for the production of oil from coal. Meanwhile, it is encouraging the establishment of plant for carbonizing coal at low temperatures, and another will be in production in South Wales next year.

Observations of the Longest Eclipse

INFORMATION has come to hand of the success of Prof. J. Q. Stewart, of Princeton University, and Mr. T. Stokley, director of the Planetarium in Philadelphia (representing the Franklin Institute and the Cook Observatory), in observing the recent total solar eclipse for an uninterrupted period of 7 min. 6 sec. from the S.S. *Steelmaker* of the Isthmian Steamship Co. The ship was at 133° 38′ W., 9° 49·5′ N. and the sun's altitude was 75°·8′. Owing to the ship's motion, totality lasted an extra four seconds for the observers. Prof. Stewart was engaged in visual study of the corona, while Mr. Stokley took photographs of the corona and measures of its total brightness at mid-eclipse. Preliminary measures show that this was of the same order as that of the full moon, while the observers on Canton Island have reported a value about half the full moon. The difference is in the opposite sense to what would be expected from purely geometrical considerations of the amount of low corona uncovered. The eclipse is described as a bright one. Despite the shadow extending around in all directions for seventy-seven miles, there was no need of flashlights to read the instruments, while ordinary newspaper print could be read with ease. Only Venus, Mercury and a few first magnitude stars could be seen, and there was indication of a high layer of haze in the sky. The corona was of late intermediate type, approaching maximum, made up of radial spikes and with no very long streamers.

Price Chair of International Economics

THE Council of the Royal Institute of International Affairs announces the appointment of Prof. Allan G. B. Fisher, of the University of Western Australia, to the newly established Price chair of international economics at Chatham House. The purposes of the chair is to provide the Institute with the means for more intensive research into world economic problems than has hitherto been possible. Prof. Fisher is the first occupant of this chair, and will consequently inaugurate the new development in the Institute's activities which has been rendered possible by the recent generous gift of £20,000 made by Sir Henry Price for this specific purpose. Prof. Fisher, who was born at Christchurch, New Zealand, in 1895, has been professor of economics in the University of Western Australia since the beginning of 1936. He has contributed widely to periodicals dealing with economics, and has published two books, "Some Problems of Wages and their Regulation in Great Britain since 1918", and "The Clash of Progress and Security". Prof. Fisher hopes to take up his new post at Chatham House early in 1938.

Avebury

Two years ago, Mr. W. G. A. Ormsby-Gore, then First Commissioner of Works, urgently directed attention to the necessity of taking steps by means of a planning scheme to preserve the surroundings of Avebury, constituting in their entirety, as he pointed out, the most imposing monument of prehistoric civilization in the whole world. He then expressed the hope that it would not be long before such a scheme was initiated. There is now a prospect that this hope may be fulfilled. A scheme under the Town and Country Planning Act, 1932, has been prepared, which, if the necessary financial provision is made, will be put into operation before the main Wiltshire Planning Scheme, for the planning and preservation of the village of Avebury and its immediate surroundings. This scheme involves the prohibition of building in certain areas, and its restriction in others. The area covered by the prehistoric remains will be preserved for ever from building, and this, with the willing co-operation of the owner, also applies to the grounds and building of the Manor House, of which part dates from before 1548, part from the latter half of the sixteenth century. Over the main part of the downland, upon which the charm of the monuments and their appeal to the historic imagination so intimately depend, no new building will be allowed, except for agricultural purposes and necessary extensions of existing buildings, while the harmonious character of new cottages will be ensured and the planting of trees continued. To some small extent the village has encroached on the monument, but condemned cottages will not be re-erected. The agricultural character of the district will be preserved, and provision made for its future prosperity by the setting aside of adequate sites for new buildings.

This scheme will cost money. It is estimated that a sum of £11,000 will be required to meet the cost of compensation and other charges necessary to carry out the provisions of the scheme. Towards this, the sum of £4,000 already has been promised privately. An appeal for the balance is made by Sir Ernest Wills, Lord Lieutenant of Wiltshire, the Marquess of Bath, chairman of the County Council, Sir Philip Sassoon, First Commissioner of Works, Mr. W. G. A. Ormsby-Gore, Lord Baldwin and others. The National Trust has undertaken to receive subscriptions and hold the funds for the purpose of the Scheme, which will be controlled partly by a special body composed of representatives of the County Council, the Rural District Council, the Parish Council, H.M. Office of Works, the Council for the Preservation of Rural England, and the Wiltshire Archæological and Natural History Society, and partly by the National Trust. In view of the number of prehistoric monuments of the first importance in the neighbourhood of Avebury—Windmill Hill, Silbury Hill, Overton Hill, the Avenue, the Roman Road, to name the most prominent only—the price of preservation is small, and the appeal should meet with a ready response from the public.

Mesolithic Site in Surrey

An important mesolithic site consisting of a group of pit-dwellings has been excavated by Dr. J. G. D. Clark near Farnham, Surrey. It was discovered by Mr. W. F. Rankine, a local archæologist, and has been described as "without any parallel in this country". (*The Times*, July 20.) The pits are circular and some three feet deep by about twelve feet across. One of the dwellings shows the site of a hearth, in which the blackening by fire can still be seen. Several hundred microlithic implements have been found, as well as a fine pointed-butt axe or pick, about five inches long. It is suggested that the settlement may be dated at about 3000 B.C., that is towards the close of the Mesolithic period, to which Dr. Clark in his studies of the Mesolithic period in Northern Europe has assigned a dating of from 8000 B.C. to 2500 B.C., when the full-fledged Neolithic culture takes its place. It would appear that this find gives an entirely new conception of the character of the mode of life of the Mesolithic peoples, which here at least would appear to have entered on a more or less settled stage. Other sites previously investigated afford little or no indications of permanent habitations, the inhabitants having lived in shelters, wind screens or skin tents as did the prehistoric inhabitants of North America and the less advanced of the recent Indians.

Necessities of Scientific Training

In his presidential address delivered at Harrogate on July 6 to the Society of Chemical Industry, Lord Leverhulme emphasized the value of a scientific training whether a man's business career is on the technical side of industry or not. Scientific method and the scientific habit of thought have an application far beyond the confines of technical research and technical processes, and Lord Leverhulme referred in particular to the importance and value of a scientific study of markets involved in market research and forecasting, as well as to the development of scientific methods of management commencing with the ideas and methods of Taylor. Referring to the synthetic production of an increasing number of our raw materials, he suggested that this development indicates an economic revolution, the proximity and scope of which are as yet insufficiently appreciated and that the time is not far distant when man, largely independent of the accident of geographical or climatic environment, will rely very considerably on the chemist to provide substitutes. The chemist is a brilliant example of the truth that scientific research leads through the elimination of waste to the conservation of resources. In an age of industrial research directed to the production of immediately practical results, the question arises whether, in the highly developed sciences, we have gone too far in the direction of intensive scientific research with the object of gaining immediate benefits at the expense of more general research in the less developed sciences which might ultimately yield social benefits of no less value, though more remote. Lord Leverhulme suggested that if the law of diminishing returns operates in scientific research, it might well be better to devote more of our resources to the less developed and less immediately profitable sciences.

Chemistry, Past and Present

IN Prof. G. G. Henderson's absence, owing to the death of Mrs. Henderson, his medallist's address at Harrogate on July 6 to the Society of Chemical Industry, "A Retrospect of Chemical Science," was read by his colleague at Glasgow, Dr. D. T. Gibson. Prof. Henderson, an original member of the Society, who in 1888 was responsible for organizing the first annual meeting in Glasgow, reviewed developments in chemistry in the last sixty years, including present-day tendencies, and in referring to post-War advances in applied chemistry in Great Britain, commented on the increasing demand for the services of chemists not only by chemical industries but also by many other industries, and on the marked appreciation of the importance of chemical research. In particular, he referred to the importance of the contribution of the chemical engineer in the development of chemical industries, as indicated by the provision of facilities for his training, and the foundation of the Institution of Chemical Engineers and of the Chemical Engineering Group of the Society. The future prosperity of Great Britain, Prof. Henderson urged, largely depends on the support given to the progress of science and especially of chemistry, and in this matter a united profession is of the utmost importance if its influence on public opinion or on Government departments is to be effective. For this reason, he pleaded for generous support of the Chemical Council and the scheme for a Chemistry House, and in particular urged that important firms employing considerable numbers of chemists should do more to encourage their staffs to become individual members of at least one of the publishing societies.

"Applied Anthropology"

IN view of the frequency with which, it is now generally recognized, problems of administration among backward peoples are intimately bound up with matters of belief and custom, and give rise to problems of which the many ramifications cannot be understood, or perhaps even perceived, without anthropological study, or upon which it may be necessary to seek the advice of the expert anthropologist, an announcement made by the Royal Anthropological Institute is both welcome and opportune. The Council of the Institute, it is stated, has appointed a Standing Committee on Applied Anthropology, which will meet at regular intervals for the discussion of problems of culture contact and the application of anthropological knowledge to the government of subject races. The Committee will seek to stimulate popular and official interest through the publications of the Institute, representations to Colonial Governments through the Colonial Office, and personal contacts with officials. It will also endeavour to further the organization and systematization of research in this field by means of discussion within the Committee and with experts engaged in research, and by promoting field-work according to a considered plan. A programme of typical questions affecting administration and upon which further research is desirable, has already been drawn up. In view of the wide connexions of the Institute and its close relations with those having expert knowledge in every part of the Empire, the work of the Committee cannot fail to be of the greatest utility in promoting a wise and enlightened policy in the administration of the affairs of the less-advanced races for whom the Imperial Government is responsible.

Need for the Study of Human Biology

IN an address at the celebrations of centenary of the University of Michigan on June 17, Prof. Raymond Pearl emphasized the necessity of evolving a science of human biology broad enough to synthesize our knowledge of man's mental and spiritual nature as well as of his physical nature if civilization is to survive. Our rapid advance in material things, while in wisdom and goodness little or no advance has been made, renders our development so lopsided as to threaten a catastrophe. The data for the unification of human knowledge do not yet exist, and one of the main challenges of the present situation to the man of science is that by natural aptitude and training he is the best equipped to obtain such data. Prof. Pearl believes that the universities, rather than specially founded independent institutions, offer the best environment for scientific research, and the achievements of the last hundred years encourage the belief that progress will continue.

The Bournemouth Outbreak of Typhoid Fever

THE report of the late Dr. Vernon Shaw, on his investigations into the outbreak of enteric or typhoid fever that occurred in Bournemouth, Poole and Christchurch in August and September 1936, has been issued by the Ministry of Health (Reps. on Pub. Health and Med. Subjects, No. 81. London: H.M. Stationery Office. 9*d.* net). The outbreak was first brought to the notice of the Ministry on August 21, 1936, and Dr. Shaw began his investigations the following day. He was informed that thirty cases of enteric fever had been notified during the preceding twenty-four hours, and that a number of other patients, scattered throughout the three towns, were under observation. The only factor common to all the patients was the consumption of raw milk retailed by one distributor. It was concluded that the milk was infective for a period of about thirty-one days preceding August 22, and the approximate number of persons who contracted the disease was 718, of whom 518 were residents, and of these fifty-one died. No source of infection could be discovered among those distributing the milk, nor at the retailer's depot. The supply was collected from thirty-seven farms scattered throughout a large part of Dorset. Dr. Shaw was satisfied that the outbreak was due to the consumption of raw milk, and that the dealer's supply was infected by the contributions of one or possibly two producers whose milk in turn was infected by water from a contaminated stream. Immediately the outbreak was recognized, the distributor, acting on Dr. Shaw's advice, pasteurized the whole of his supply, and no unpasteurized milk was distributed after the morning round on August 22. This measure was immediately successful in terminating the outbreak.

Poetry and Astronomy

DR. F. W. Grover, professor of electrical engineering, Union College, Schenectady, N.Y., has contributed to the *Scientific Monthly* of June an article in which are brought together a number of striking passages in poetry referring to astronomical objects and phenomena. Milton, Dante, Tennyson and Longfellow are naturally given the chief prominence in these extracts, but there are also beautiful passages from Browning, Housman and others. Dr. Grover refers appreciatively to Mr. Alfred Noyes's "Watchers of the Sky", but wonders why the new knowledge of the starry heavens makes so small an appeal to contemporary poets, whose fancies rarely stray into this virgin field. "Yet," he says, "it would be a fascinating task, and one demanding no mean ability, to picture the whirl of the spectroscopic binaries, and the rhythmic oscillation of the Cepheid variables, to describe the individualities of the giant and dwarf stars, or to soar in imagination to the confines of an expanding universe."

Progress in Gliding

RECENT numbers of the *Sailplane and Glider*, the official organ of the British Gliding Association, give evidence not only of the advances that have been made in the technique of motorless flight, but also of the scientific knowledge that it is producing. The development of aeroplanes has been so spectacular that development of sailplanes may be overlooked. But these have attained an airspeed of 87 m.p.h., a straight line distance of 313 miles and a height of more than 19,000 feet; records all beyond those of power planes in 1911. It has long been a reproach that sailplanes were dependent on hills and winds; but an effort was made last June to meet this by the organization of a cross-country circular tour. A definite route of 415 miles, beginning and ending at Darmstadt, was laid out, the time allowed being ten days and each separate flight was to start with an aeroplane tow to not more than 500 metres. Of the eight pilots who got away, four completed the course in the time, the first taking only seven days. The use of 'thermals'—ascending currents apart from clouds—has become more widespread. Of late, at four or five English gliding centres, pilots have been pulled up to a few hundred feet by a winch and have got away without any help from the wind or from a hill.

ON the scientific side, the practice of soaring inside clouds, as well as the use of thermal currents and of cold fronts, has given valuable meteorological knowledge. Soaring in clouds not infrequently proves adventurous. Last June, for example, a German pilot went into a cloud to gain height and his rate of ascent increased from 4 m. a second to beyond what his variometer would register. When he was at 16,400 feet he tried in vain to get out of the cloud; he was tossed up and down, thoroughly chilled and bombarded with hail; the climax came when a wing broke off. However, the pilot with difficulty got clear, and descended to safety in his parachute. Naturally those who take such risks want to learn all they can about the conditions; and while some carry special recording instruments, others work out the paths of air in thermals or make and study fast-motion cloud pictures. As an illustration of the data brought by such means may be quoted the records of pressure, temperature and humidity obtained during a flight from the Chiemsee across the Tyrolese Alps into Italy; the pilot rose to 10,800 feet to cross the Gross Venediger. Meteorologists doubtless have shrewd ideas as to what goes on in such places as cloud-cells and lenticular clouds; but there, as well as in many other regions, definite observations must have the highest possible value.

Monthly Meteorological Elements

IN the *Meteorological Magazine* of June there is a new feature that has been developed as a result of a proposal made by Prof. A. Wagner at the International Meteorological Conference at Copenhagen in 1929, that monthly mean values of various meteorological elements should be broadcast as soon as possible after the end of each month for selected meteorological stations. The arrangements for carrying out this proposal were completed and ratified at the Warsaw Conference in 1935, and provided for the inclusion in the broadcasts of mean pressure in millibars or millibars and tenths of a millibar, mean temperature in degrees and tenths, total rainfall in centimetres, and, for certain places, resultant air transport for the month. Since the first broadcasts were made in June 1936, the selected stations have increased in number, and data for Russia, Siberia and America are now included. The figures for May 1937, except those for air transport, have been discussed in the journal mentioned above, pressure and temperature being plotted so as to show cartographically the main features of those elements of the weather for that month over a large part of the northern hemisphere. The interesting fact emerges that the excess of temperature above the average for 1901–30 in the British Isles, which ranged from 1° to 3° F., was also experienced throughout Europe and the greater part of North America, the excess being more than 5° F. over the north-east of Europe, most of Scandinavia and northern Canada and part at least of the Nile valley. The warmth of Europe and North America is seen to be associated with, if not due to, a lowering of mean pressure in the arctic regions and Siberia, combined with an excess of pressure over most of Europe, the United States and southern Canada. This information was available at the Meteorological Office within seven days of the conclusion of the month under review.

Wear of Motor-Car Engine Cylinders

THE problem of cylinder wear has now become very serious in commercial and public service vehicles, according to an article in the January issue of the *Nickel Bulletin*. This is due to the new designs giving higher efficiency, and also the use of aluminium pistons. Wear is considered to be due to a combination of two causes: mechanical abrasion and the corrosive attack of the cylinder walls by the products of combustion. The former predominates in vehicles running for long periods with a hot engine such as motor-buses used for long-distance runs in daily service. The latter effect is the more important for vehicles which run intermittently with long waits between runs, like delivery vehicles. In these the engines never get properly warm. The development of nickel cast iron has provided a satisfactory solution. The addition of one or two per cent of nickel to a suitable composition of base iron has produced cylinder castings which are readily machinable and yet have a high Brinell hardness. Recently the manufacturers of many commercial vehicles have obtained excellent results by using heavily alloyed iron. The cylinders of both petrol and Diesel vehicles are now being regularly made of irons containing 4–5 per cent of nickel with or without proportions of chromium and molybdenum. Improved machinability is obtained by slowly cooling the castings from a temperature of about 650° C. When this course is followed, the original hardness is restored after machining by air-cooling the material from a temperature of about 850° C. In France, this hard type of iron has been used for several years with satisfactory results for air-cooled motor-cycle cylinders.

International Union of Biological Sciences

PROF. M. J. SIRKS (Wageningen, Netherlands), secretary of the above Union, reports that the next General Assembly will probably be held in July 1940 at Stockholm immediately before the seventh International Botanical Congress. The president is Prof. E. D. Merrill (Harvard) and the vice-president, Prof. D. M. S. Watson (London). The report in NATURE (136, 612; 1935) on the International Botanical Congress at Amsterdam in September 1935 referred to the establishment of a liaison between the Congress and the Union. Dr. F. Verdoorn (Leyden), secretary of the Botanical Section of the Union, reports on the work of this Section, which was deputed to execute the resolutions passed by the Congress and to assist the various commissions and committees then appointed. He reports that an index of current plant science periodicals, prepared by the Commission for Documentation, will be issued during 1937, and that the Commission for Urgent Taxonomic Needs is preparing an "Index Herbariorum". Suggestions or questions bearing on botanical nomenclature should be sent to Dr. T. A. Sprague, Royal Botanic Gardens, Kew, secretary of the Commission of Nomenclature.

Scientific Annual Publications: New ASLIB List

A SIXTEEN-page booklet has been issued by the Association of Special Libraries and Information Bureaux as a supplement to the ASLIB Book List, containing classified particulars of 212 recommended annual publications of scientific and technical interest, published in the English language. The publications are arranged by subjects, and include representative U.S.A. publications as well as those of the League of Nations and many of H.M. Government reports, etc., which are not often found in Press guides. The list should be of considerable service to information officers and those in charge of reference libraries or intelligence departments. The List can be obtained from the Association of Special Libraries and Information Bureaux, 31 Museum Street, W.C.1, at a charge of 2*s*. per copy to subscribers to the ASLIB Book List and 3*s*. 6*d*. to non-subscribers.

International Congress of Anthropological Sciences

ARRANGEMENTS are now announced for the second International Congress of Anthropological and Ethnological Sciences to be held at Copenhagen on August 1–6, in accordance with the decision taken at the first congress in London in 1934. It will be under the patronage of H.M. the King of Denmark and Iceland. The Congress will meet in seven sections, covering respectively physical anthropology, psychology, demography, ethnology, ethnography in six sub-sections according to geographical areas, sociology and religion, and linguistics and writing. Arrangements have been made for exhibitions and demonstrations in connexion with the subjects to be discussed, among them anthropological material of the Eskimo and Scandinavians of Greenland in the Middle Ages, and from the prehistoric burials of Denmark, and the skulls of Lagoa Santa, Brasil. There will be a demonstration of the relation of the ancient dwellings of Denmark and the structural systems of prehistoric times, which will take place at the Lyngby Folk Museum, where there will also be an exhibition of Danish national dances, including those of the Faroe Islands. A collection will be on view of medieval Icelandic manuscripts referring to the discovery of Greenland and Vinland, as well as the manuscript of Pomo de Ayala on the Kingdom of the Incas and Peru, recently published by the Institut d'Ethnologie de Paris, and manuscripts of the Iranian Avesta. The Ethnographical Museum, which has been closed for several years for enlargement and is the oldest in Europe, having been founded in 1846, will be reopened to the public for the first time at the meeting of the Congress. At the close of the session, an excursion will be made through Denmark, on which visits will be paid to kitchen-middens, Megalithic tombs, tumuli of the bronze age, iron age fortifications, the new Viking ship recently discovered at Ladby, and other antiquities of the Middle Ages. Subscriptions (members 30 Danish crowns, associates 15 Kr.) may be addressed to the Treasurer of the Congress, Nationalmuseet, 10 Ny Vestergade, Copenhagen, K.

Seventeenth International Geological Congress

THE seventeenth International Geological Congress is being held in Moscow on July 20–30, as noted in NATURE of January 23, p. 143. Many tours for the delegates have been arranged; for this purpose guide-books have been prepared giving detailed descriptions of the routes, all the interesting outcrops of mineral strata, the deposits of useful minerals, etc., with maps, plans and sectional drawings. Every delegate has a set of twenty-eight guide-books, and a newly issued geological map of the Soviet Union; each tour is being conducted by a Soviet geologist. According to a report issued by the Soviet Union Year Book Press Service, 403 foreign delegates, representing forty-six different countries, are attending the Congress; they include 139 from the United States, 50 from Great Britain, 33 from France, 20 from Japan and Manchukuo, 13 each from Germany and South Africa, and 11 from Sweden. Of Soviet geologists, 1,600 have intimated their desire to be present, but as many of them are at present engaged in field work, not all of them will be able to attend. The delegates will spend two days in Leningrad, where a session of the Congress will be held, and visits will be paid to the geological museums of the Mining Institute, the Central Institute of Scientific Research, the Arctic Institute, to give representatives of foreign countries an opportunity of becoming acquainted with the general characteristics of the mineral resources of the Soviet Union. In Moscow, the Congress will hold its sessions at the Observatory, where the institutes of the Academy of Sciences of the U.S.S.R. have also arranged an exhibition of collections relating to mineralogy, geochemistry and useful minerals, and the Palæontological Institute is showing its collection of Perm vertebrates of the North Dvina Gallery. Among the subjects coming up for discussion at the Congress are: problems of oil and world oil resources; geology of coal deposits; the Pre-Cambrian system and its useful minerals; the Perm system and its stratigraphical arrangement; the inter-connexion of tectonic processes, magmatic formations and ore deposits; tectonic and geochemical problems of Asia; deposits of rare elements; geophysical methods in geology; geology of the Arctic and Antarctic.

Beit Fellowships for Scientific Research

THE Trustees have awarded Beit fellowships for scientific research, tenable at the Imperial College of Science and Technology during the academic year 1937–38, as follows: extensions of fellowships already satisfactorily held for one year to Dr. N. Kemmer, for the continuation of his work on the theoretical studies in nuclear physics, under the direction of Prof. S. Chapman; and to E. K. Woodford, for the continuation of his research in plant physiology, the work to be done under the supervision of Prof. F. G. Gregory; new fellowships tenable for one year, but renewable for a second, to D. W. Goodall, for research on the physiology of the tomato plant, under the direction of Prof. F. G. Gregory; H. A. C. McKay, for an investigation of chemical problems by the radioactive indicator method, under the direction of Prof. J. C. Philip; A. K. Powell, for research on the various strains of *Heterodera Schachtii*, under the direction of Prof. J. W. Munro. The Trustees have also awarded a special Beit research scholarship to Dr. A. G. Gaydon, for research in spectroscopy under the direction of Prof. G. P. Thomson.

Announcements

GEHEIMRAT PROF. ERICH LEXER, professor of surgery in the University of Munich, and the chief representative of plastic surgery in Germany, has been awarded the Goethe Medal for art and science on the occasion of his seventieth birthday.

THE sixth International Montessori Congress will be held in Copenhagen under the auspices of the Danish Minister of Education on August 1–10. Dr. Maria Montessori will give an address entitled "Educate for Peace". Further information can be obtained from the General Director, International Montessori Association, 1 Hampstead Hill Gardens, London, N.W.3.

ACCORDING to official reports, the birth-rate in Soviet Russia is steadily increasing. Last January, the number of births registered was 21·7 per cent higher than in January 1936, and in the first quarter of this year it was about 30 per cent higher than in the corresponding quarter of 1936. Of the Union republics the Ukraine records the largest increase for the quarter, namely, 70 per cent.

THE University of Reading proposes to reprint, in type similar to that of the original and accompanied by wood-cuts of the original drawings, the "Observatories Anatomicæ Selectiores Amstelodamensium", 1667–73. This work, the record of the observations of the Amsterdam School on the anatomy of seven mammals, four birds, the tortoise, the frog and thirteen fishes, is rare and its contents not widely known among biologists. Prof. F. J. Cole, to whom subscriptions for copies (1 guinea each) should be sent, is contributing a critical introduction.

ERRATUM.—In the announcement in NATURE of July 17, p. 104, of the award of the Johannes Schmidt Medal to Mr. H. G. Maurice the words 'thirteenth annual meeting' should have been 'thirtieth annual meeting'.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 158.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Packing Fractions of Krypton and Xenon

THE lines produced in mass spectra by hydrocarbon molecules have always played a predominant part in the accurate measurements of mass. This is particularly so in the use of the doublet method, since their high masses, due to the hydrogen, tend to provide easily resolvable doublets with ordinary atomic lines. With methane and ethane there is no difficulty in producing all the lines of the C_1 and C_2 groups, but when propane is used in a cylindrical discharge tube, only the first four lines of the C_3 group, 36, 37, 38 and 39, have a workable intensity. These were used in the measurements of the isotopes of chlorine[1]. Fortunately, the lower pressure discharge in an eight-inch bulb gives all the lines up to C_3H_8, though the even ones, 40, 42, 44, are weaker than the others. This has enabled comparisons to be made with the multiply charged lines of krypton and xenon, giving direct measurements of their packing fractions much more accurate than the indirect ones made ten years ago[2]. The following are the results :

Doublet		Number of doublets measured	Difference in packing fraction	Difference of mass
^{78}Kr++	– C_3H_3	4	16·28 ± 0·2	0·0635
^{82}Kr++	– C_3H_5	19	20·20 ± 0·15	0·0828
^{84}Kr++	– C_3H_6	20	21·73 ± 0·15	0·0913
^{86}Kr++	– C_3H_7	18	23·10 ± 0·15	0·0993
^{129}Xe+++	– C_3H_7	14	20·16 ± 0·1	0·0867

Presence of traces of argon in the tube prevented any accurate determination of ^{80}Kr. Measurements of ^{132}Xe+++ by the doublet at 44 were unsatisfactory owing to the presence of CO_2, but its packing fraction appears to be nearly the same as that of ^{129}Xe, and is given provisionally.

The following are the packing fractions and isotopic weights deduced from values of hydrogen and carbon of 1·00812 and 12·00355 respectively :

Symbol	*Packing fraction*	*Isotopic weight*
^{78}Kr	– 7·30	77·9430 ± 0·0020
^{82}Kr	– 7·70	81·9369 ± 0·0015
^{84}Kr	– 7·60	83·9362 ± 0·0015
^{86}Kr	– 7·40	85·9363 ± 0·0015
^{129}Xe	– 4·46	128·9424 ± 0·0020
^{132}Xe	(– 4·4)	(131·942)

F. W. ASTON.

Cavendish Laboratory,
Cambridge.
July 9.

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[1] NATURE, 138, 1094 (December 26, 1936).

[2] *Proc. Roy. Soc.*, A, 115, 506 (1927).

The Two Crystalline Modifications of Insulin

PROF. E. B. MATHEWS' first examination of Abel's crystalline insulin showed the presence of two types of insulin crystals[1]. One of these, the so-called prismatic or needle variety, had marked birefringence and a development of faces strongly suggestive of rhombohedral symmetry, the crystals being elongated along the trigonal axis. Crystals of this type are commonly wedge-shaped, and very small wedge-shaped crystals have also been obtained by Scott[2] by crystallization of insulin from acetate buffers at *p*H 5·2. The more common variety of insulin crystals are those obtained first by Abel[3] from phosphate buffers at *p*H 6·2. These are very small flat rhombohedra appearing isotropic as usually viewed along the trigonal axis, but having actually positive birefringence. X-ray examination has here shown the presence of a simple rhombohedral unit cell[4]. It has been usual in the literature to describe these two forms—prismatic and rhombohedral—as polymorphic modifications[5].

Through the kindness of Prof. F. L. Pyman, I have now had the opportunity of examining also insulin crystals of the prismatic type by the X-ray method. Two preparations were available. One of these consisted of very small crystals roughly wedge-shaped in outline and frequently twinned in cross forms as described by Mathews. As these crystals were only 0·05 mm. long and less than 0·01 mm. across, they could not be used for X-ray measurements. But there seems no doubt that the second preparation is identical with this, though here the crystals showed no identifiable faces. They were roughly needle-shaped masses up to 0·3 mm. long and rather less than 0·1 mm. in cross-section, extinguishing uniformly between crossed nicols and showing, as do the small wedge-shaped crystals, positive birefringence.

These needle-shaped crystals gave on X-ray examination photographs identical in the spacings and intensities of the X-ray reflections with those obtained from the original 'rhombohedral' crystals. The crystal structure is therefore the same in the two forms, and these are not polymorphic modifications though the change in habit is certainly very striking. Even here there is evidence that forms intermediate between the two varieties may occur. One sample of insulin, recrystallized from sodium dihydrogen phosphate and acetic acid, consisted very largely of small crystals showing nearly equal development of rhombohedral and prismatic (or more probably steep trapezohedral) faces, which gave them at first sight the appearance of rhombic dodecahedra. These crystals were much too small for X-ray examination, but the possession of positive birefringence combined with the symmetry leaves little doubt of their identity with the other two varieties.

In one respect only do the X-ray photographs of the needle crystals appreciably differ from those of the original rhombohedra. They all show a much more marked diffuse ring with a spacing of about 4·5 A., a value we have come to consider characteristic of the presence of 'amorphous' proteins[6]. Here it may be due to imperfections of the crystal following perhaps partial breakdown. But amorphous proteins such as gelatin are known to have a marked effect on the habit of both organic and inorganic crystals; and it seems possible that a similar influence appears here, amorphous insulin or a breakdown product being included in the crystals and being itself responsible for the adoption of the prismatic form.

D. CROWFOOT.

Dept. of Mineralogy,
Oxford.
June 29.

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[1] Abel, J. J., Geiling, E. M. K., Rouiller, C. A., Bell, F. K., and Wintersteiner, O., *J. Pharm. Exp. Ther.*, **31**, 84 (1927).

[2] Scott, D. A., *Trans. Roy. Soc. Canada*, (iii), **26**, 275 (1932).

[3] Abel, J. J., *Proc. Nat. Acad. Sci.*, **12**, 132 (1926).

[4] Crowfoot, D., NATURE, **135**, 591 (1935).

[5] cf. "Insulin" by D. W. Hill and F. O. Howitt (p. 51).

[6] cf. Astbury, W. T., Dickinson, S., and Bailey, K., *Biochem. J.*, **29**, 235 (1935).

Absolute Configuration of the Naturally Occurring α Amino-Acids

THANKS largely to the extensive researches of Levene and his collaborators, it now appears to be well established that, as suggested by Clough in 1918[1], the naturally occurring α amino-acids all possess the same configuration. Until recently, the absolute configuration was not known for any optically active compound, but in the course of a theoretical calculation of rotatory power, Boys[2] deduced a rule giving the absolute configuration of any enantiomorph from the sense of its rotation—namely, "that a dextro compound has the configuration such that, when the largest group is nearest to the hypothetical observer the other groups in order of diminishing size appear in a clockwise rotation".

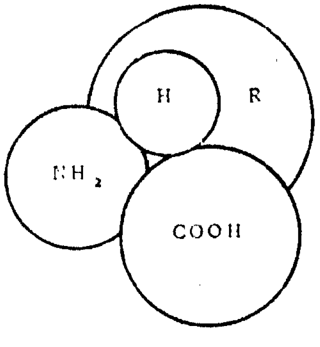

Fig. 1.

Boys's rule, which appears to have been accepted by Levene and Lowry, can only be applied with certainty in the absence of interactions of the solvent with the solute molecule, a condition which is far from being fulfilled by the amino-acids; marked solvent action is indicated in several cases by a complete change of sign of the rotation with temperature or with *p*H. The configurations of the amino-acids have, however, been correlated with those of other compounds in which solvent action is less; from the recent paper of Levene and Mardashew[3], the naturally occurring amino-acids have the configuration of lævo-rotatory 2-amino-hexane, a compound to which Boys's rule may be applied with more confidence.

If the validity of the rule and its applicability to this amine be accepted, then the naturally occurring α amino-acids, which amount to more than 95 per cent of most proteins, can be assigned the absolute configuration given in Fig. 1.

R. C. RAINEY.

London School of Hygiene and
Tropical Medicine.
June 22.

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[1] Clough, G. W., *J. Chem. Soc.*, **113**, 526 (1918).

[2] Boys, S. F., *Proc. Roy. Soc.*, A, **144**, 655 (1934).

[3] Levene, P. A., and Mardashew, S., *J. Biol. Chem.*, **117**, 707 (1937).

Use of Krypton-filled Ionization Chambers for Cosmic Ray Measurements

SOME years ago, compressed air and nitrogen were replaced by argon in cosmic ray ionization apparatus[1], argon being approximately twice as effective as nitrogen, which in turn is more effective than air.

Krypton is now used for filling special incandescent electric lamps, and is thus more easily available than hitherto. It was *a priori* probable that this gas of high atomic number would give much more favourable results than argon. The Gesellschaft für Lindes Eismaschinen, Germany, has kindly supplied me with compressed gas containing 94·5 per cent krypton and 5·5 per cent xenon. An ionization chamber was filled with the gas under a pressure of 12 atm. Only a few measurements could be carried out with the apparatus, as in consequence of an accident the greater part of the gas was lost. Nevertheless, the results obtained seem to be of interest to workers in that domain of science.

I had at my disposal two almost identical ionization chambers which were alternately filled with dry air under atmospheric pressure and with compressed krypton, argon or nitrogen. The chambers were of steel 5 mm. thick, had a volume of about 900 cm.^{3} each and their central electrodes were connected with Lindemann electrometers; they were exposed to the γ-rays from 0·4 mgm. radium at a distance of 120 cm.

Denoting by I_{air} the ionization in air of normal pressure and temperature, it was found:

$$I_{\mathrm{N_2}}^{15\cdot5\ \mathrm{atm.}}/I_{\mathrm{air}} = 9\cdot5\,;\quad I_{\mathrm{Ar}}^{15\ \mathrm{atm.}}/I_{\mathrm{air}} = 18\cdot9\,;$$

$$I_{\mathrm{Kr}}^{12\ \mathrm{atm.}}/I_{\mathrm{air}} = 40\cdot2.$$

The ionization at these relatively low pressures is roughly proportional to pressure[2]. Reducing all measurements to the same pressure of 12 atm., we obtain the following relative ionization values for nitrogen, argon and krypton: 7·4; 15·1; 40·2. The nitrogen and argon used were of high purity; with commercial products, the superiority of krypton would be still more marked.

The γ-ray and cosmic ray ionization are generally proportional to each other. I undertook some experiments to test it in the case here concerned. My results are too incomplete to be quoted. It has been found, however, that the ionization due to cosmic rays is more than twice as great in krypton as in argon. It is thus obvious that the substitution of argon by krypton in ionization chambers will give a gain even more considerable than that which was formerly obtained by substitution of air by argon. The usefulness of krypton for Geiger-Müller counters in cosmic ray research is also obvious.

Part of the expense for this investigation was covered by a grant from the Ministry of Education.

ST. ZIEMECKI.

Main School of Agriculture,
Physical Laboratory,
Warsaw.
June 10.

[1] Compton, A. H., and Hopfield, J. J., *Phys. Rev.*, **41**, 539 (1932).

[2] Hopfield, J. J., *Phys. Rev.*, **43**, 675 (1933).

Ionization Energy of Li^+ and He

As a disagreement was found by Robinson[1] between measured and calculated values for the ionization potential of Li^+, I have made a direct calculation by the method described by Hylleraas[2]. The ionization potential in the 13th approximation is found to be 610,058 cm.$^{-1}$. This result is in good agreement with the value 610,054 cm.$^{-1}$ obtained from the Hylleraas' extrapolation formula for $Z = 3$.

To this value the following corrections are to be applied[3]: ε_2 (mass polarization correction—the elementary mass correction is contained in R_Z and therefore already taken into account), H_1 (relativistic change of mass with velocity), H_2 (magnetic interaction between the orbits), H_4 (spin correction, arising from a characteristic term in the Dirac theory), H_l (relativistic correction for the remaining ion with one electron).

I have calculated the most important of these corrections, H_1 and H_4, using the best wave function with four terms. Bethe has made the same calculation using a less accurate wave function.

TABLE 1. RELATIVITY CORRECTIONS.

Correction unit	H_1 a^2R	H_4 a^2R	H_l a^2R	Total a^2R	Total (cm.$^{-1}$)
New value	153·8	− 125·1	− 20·3	+ 8·4	+ 49
Bethe's ,,	130·4	− 111·6	− 20·3	− 1·5	− 8

H_2 is found to be very little ($= -2$ cm.$^{-1}$). Other corrections seem to vanish in our approximation.

TABLE 2.

Unperturbed ioniz. pot. (cm.$^{-1}$)	Total corrections H (cm.$^{-1}$)	Mass pol. corr.[4] (cm.$^{-1}$)	Total calculated (cm.$^{-1}$)	Experimental value[1] (cm.$^{-1}$)
610,058	47	− 5	610,100	610,079 ± 25

For He the agreement is not so good: the calculated value is 198,325 cm.$^{-1}$ (the unperturbed value is calculated by Hylleraas) and the experimental result is 198,305 ± 15 cm.$^{-1}$ (measured by Paschen). It seems that the theoretical values (even for heavier elements) lie somewhat higher than the experimental values, so the disagreement cannot depend upon the use of the variational method.

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[1] Robinson, *Phys. Rev.*, **51**, 14 (1937).

[2] Hylleraas, *Z. Phys.*, **65**, 209 (1930).

[3] Bethe, "Handb. d. Physik", vol. 24/1, p. 324, *et seq.*

[4] Edlén, *Nova Acta Reg. Soc. Sci. Ups.*, (7) **9**, No. 6, and Robinson, *Phys. Rev.*, **51**, 14 (1937).

The O-H Raman Frequency in Inorganic Acids

THE band characteristic of the OH group has been recorded in the Raman spectra of many hydroxides and alcohols. It has not so far been observed, however, in the case of the stronger acids. Using the improved technique of complementary filters recently developed by Ananthakrishnan[1], and giving long exposures varying from six to twelve days, I have succeeded in obtaining spectra with sulphuric acid and crystals of iodic, selenious and telluric acids, in which the band is clearly seen in the 4046 A. excitation. Table 1 gives the frequency shifts. The value for boric acid is taken from Ananthakrishnan's paper[2].

TABLE 1.

Substance	Raman frequencies of the OH band (cm.$^{-1}$)		
	Beginning	Middle	End
H_2SO_4 (100%) liquid	2794	2985	3172
HIO_3 crystals	2834	2979	3125
H_2SeO_3 ,,	2973	3057	3141
H_6TeO_6 ,,	2985	3121	3257
H_3BO_3 ,,	—	3172, 3256	—

The following points may be noted: (1) The OH frequency in these acids is represented by a band which is weak, broad and diffuse as compared with the other vibration frequencies. (2) The OH group, which gives a sharp line at 3608 in potassium hydroxide and a broad band at about 3660 in ethyl and methyl alcohols, gives a much lower frequency in the inorganic acids. (3) There is a progressive fall in the characteristic frequency shift and a diminished intensity of the band with increasing strength of the acid. (4) In the case of sulphuric acid, the band appears to be resolved into two components.

The fact that the OH band has not hitherto been recorded in the Raman spectra of acids has been regarded by some investigators[3] as supporting the hypothesis of the existence of the so-called hydrogen bond[4] in oxy-acids and their salts. Now that the OH band has actually been recorded, this view evidently requires some modification. We have in fact to postulate the existence of the OH bond in acids as well, but considerably weakened as compared with the strength of the bond in alkalis and in weak acids. It may be mentioned in this connexion that Badger and Bauer[5] have recently observed an infrared absorption band in the region of 3μ in sulphuric acid, and they ascribe it to the presence of the OH group. These authors have drawn the inference that the so-called hydrogen bond and the hydroxyl bond postulated by Bernal and Megaw[6] are only extreme cases of one and the same phenomenon. This view appears to be supported by the investigation reported above.

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June 13.

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Surface Migration of Barium

J. A. BECKER[1,2] has described experiments from which he concluded that barium, deposited on one side of a flat tungsten ribbon, could, under given conditions, move to the opposite side. The thermionic emission measurements from each side of the ribbon indicated that barium deposited on one side migrated until each side was covered with half the original amount.

We have been engaged in observing the behaviour of oxide-coated emitters on nickel and tungsten, for which purpose we have used an electron microscope. In the light of Becker's results, we were surprised to find that, although barium could spread across a nickel or tungsten surface on which it had deposited, it could do so only when evaporation was possible. Our results did not, therefore, provide any direct evidence of surface migration.

We have since repeated Becker's experiments with both nickel and tungsten. The apparatus used by Becker is only briefly described in the references[1,2] given, but in his paper[3] on the diffusion and migration of thorium on tungsten, he describes in detail the apparatus employed. In our experiments, we used an apparatus similar to that described there. In this apparatus, precautions are taken to separate the thermionic emission from each side of the ribbon.

Our results have failed to reveal any evidence of surface migration of barium either on nickel or tungsten. In each case, the thermionic current measured at any time from the clean side was considerably less than one per cent of that obtained from the contaminated side, even after 16 hours' running at 1,100° K., the temperature at which Becker concludes migration rapidly takes place.

We hope to publish full details of both our electron microscopic and thermionic investigations in the near future.

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[2] *Trans. Faraday Soc.*, **28**, 155 (1932).

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The Ground State of the Se_2 Molecule

THE diatomic molecules of the lighter elements of the sixth family of the Periodic Table, like O_2, S_2, SO, have $^3\Sigma$ terms as their ground states. There is some doubt if this still prevails with the heavier elements of that group. Spectroscopic investigations have so far not been able to show whether the ground states of Se_2, Te_2, SeO, etc., are $^3\Sigma$ or $^1\Sigma$ states.

So it appeared worth while to ascertain the magnetic properties of Se_2 vapour. With all precautions necessary to avoid contamination by oxygen, selenium was sealed in a silica tube under vacuum, and the influence of a magnetic field on it was determined at different temperatures between 20° C. and 1,100° C. The vapour in the tube consists of Se_6 and Se_2, being practically all Se_6 at low temperatures and changing more and more to Se_2 as the temperature rises. Along with the formation of diatomic molecules, a strong paramagnetic influence appeared, rapidly increasing as the quantity of diatomic vapour increased. This establishes the fact that the ground level of Se_2 is $^3\Sigma$.

A full account will be given in the *Proceedings of the Indian Academy of Sciences*, Bangalore.

Experiments on tellurium to the same effect are in progress.

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A Psycho-geometrical Representation of Personnel Organization

LARGE industrial and other concerns represent their personnel organization diagrammatically by means of a chart having the form of a genealogical table. Properly constructed, this chart gives concise information as to individual rank and duties and relations, but no information regarding fundamental functions and mentality types at different levels. Moreover, the chart conveys the impression of descent instead of growth, differentiation and organic unity. It is therefore biologically unscientific and inadequate for administrative educational purposes.

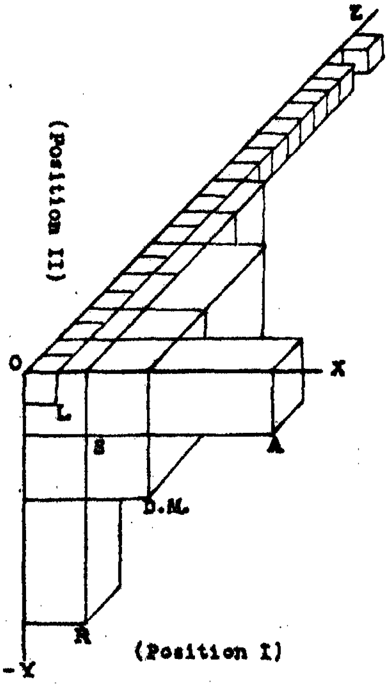

Fig. 1.

The above defects can be remedied by employing the co-ordinate system. In Fig. 1 (of which a solid model in colours has also been constructed), the *OX* axis represents breadth of knowledge or the administrative function, and *O–Y* depth of knowledge or the research function. It will be apparent that the administrative mind is represented by a horizontal rectangle (*A*), the research or advisory mind by a vertical rectangle (*R*), and departmental management, supervision and labour by squares of decreasing size (*D.M.*, *S* and *L*). *A*, *R* and *D.M.*, though always different in form and function, *may* be equal in area or total knowledge and ability. These conceptions constitute a helpful guide in educational training, including the important matter of mental contact. The projection (OZ axis) represents numbers only. It enables diagrams to be constructed representing the functional organization, in terms of mental types, of different concerns. Tentative trials have yielded interesting results. This method of representation, therefore, in psychological hands, has a research value.

It may be noted that OX also measures responsibility and power in the administrative sense. Remuneration increases from O to X in rapid geometrical progression ($r=2$); from O to $-Y$ it tends to increase only in slow arithmetical progression ($d=1$). This is due largely to demand and the factor of scarcity. It may be noted that knowledge and information characteristically pass along the path $-YOX$ and decisions or orders along $XO\text{-}Y$.

In Position II, the appearance of a building is not altogether fortuitous, since there is a fixed and real relationship between numbers and space, even if that between rank and altitude is only analogical. It may be noted that the modern idea of 'functional control' (for example, a personnel department 'intruding' into all other departments in respect of its function) can be represented clearly by lines drawn obliquely in the XOZ plane.

In the next two positions the figure facilitates the explanation of other ideas of considerable importance, but with which it is unnecessary to deal in the present communication.

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Phosphorus and Calcium Deficiency Diseases as Two Ætiologically Distinct Entities

Phosphorus Deficiency

VITAMIN D deficiency in most species of animals leads to the development of rickets, and Kay's suggestion that the real cause of experimental rickets produced under conditions of vitamin D deficiency is the assimilation of insufficient dietary phosphorus is interesting. Certainly this opinion is strengthened by the observation that low vitamin D rickets is indistinguishable from that produced by phosphorus-deficient diets in the presence of abundant vitamin D. The disease is referred to as rickets in the immature animal and as osteomalacia in the adult.

Theiler produced evidence in 1932 that rickets or osteomalacia in bovines kept under conditions of abundant vitamin D was invariably associated with insufficient dietary phosphorus. Subsequent work at this Institute has shown this to be true for other species of domestic animals in addition to the ox. Experimental rickets, due only to insufficient phosphorus in a diet adequate in all other respects, has been produced in cattle, goats, sheep, pigs, and, recently, indications of it have been observed in the horse. Details of these experiments are being published and leave no doubt that insufficient dietary phosphorus is the causal factor in the production of rickets under conditions of vitamin D sufficiency, while insufficient calcium in the diet does not produce rachitic lesions but an entirely different bone disease.

Calcium Deficiency

It is well known that low calcium in the rations of horses, especially if excess phosphorus be present, produces ostodystrophia fibrosa (Sturgess and Crawford, Kintner and Holt, Niimi, Theiler, etc.) but not rickets. Actually, true rickets in the horse has not yet been described in the literature. Furthermore, osteodystrophia fibrosa (osteofibrosis) is known to occur also in the goat, the dog and in some other animals, but so far its occurrence has not been associated with calcium-low diets.

At this Institute an 8-months old calf receiving daily in the diet 3 gm. calcium (CaO) and an excessive quantity of phosphorus (30 gm. P_2O_5), developed marked osteofibrosis and bone atrophy after 13 months. Abundant vitamin D was present. Two calves of the same age and receiving the same ration except that the phosphorus content was reduced to 15 gm. P_2O_5 developed osteoporosis and severe osteofibrosis during the same period. A fifteen months old steer receiving daily in his ration 4 gm. CaO and insufficient phosphorus (4 gm. P_2O_5) developed rickets as a result of the phosphorus deficiency shortly after the beginning of the experiment and osteofibrosis in virtue of the calcium deficiency after 31 months, severe rickets and bone atropy still being present. The same ration supplemented to contain abundant calcium (31 gm.) produced severe rickets and osteoporosis due to the phosphorus deficiency, but no osteofibrosis in a steer of the same age.

Moderate osteofibrosis was produced in a goat and in a pig receiving low calcium high phosphorus in their diets, but possibly the wide ratio of calcium to phosphorus was also responsible for the severity of the disease. Osteofibrosis has not yet been produced in sheep fed on a diet low in calcium.

Osteoporosis is merely the result of increased bone resorption; it is indicative of abnormal Ca : P metabolism, and is a transient stage in the evolution of some osteodystrophic diseases. It invariably accompanies the development of both rickets and osteofibrosis.

The most probable explanation for the relative rapidity with which rickets was produced by phosphorus-deficient diets compared with the appreciably longer time osteofibrosis took to develop when the rations were low in calcium, is that the functions of these two minerals in the animal body differ widely. Practically all the body calcium is required for bone formation and is present in the skeleton, whereas the demands for the much more widely functioning phosphorus are far more varied than for calcium. In other words, the need for metabolic phosphorus, other than that required for ossification, probably plays as important a part in the production of rickets as a deficiency of phosphorus for bone formation alone, and hence rickets due to phosphorus deficiency appears more rapidly than osteofibrosis due to a deficiency of dietary calcium.

It is interesting to note that, in all Marek's experiments with pigs, osteofibrosis was produced only when calcium was low or lower than phosphorus. No significance was attached by Marek to this apparent association of osteofibrosis with reduced calcium in the diet, probably because the work was done under conditions of vitamin D deficiency, and hence rickets developed in every case where osteofibrosis was produced, thus masking the association of osteofibrosis with abnormal calcium metabolism.

Our conclusion is that when enough vitamin D is present, a deficiency of phosphorus in the diet of cattle, sheep, goats and pigs produces rickets only, whereas a deficiency of dietary calcium produces osteofibrosis uncomplicated by rickets—certainly in cattle and horses and probably also in pigs and goats. Osteoporosis in invariably associated with both diseases.

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Effects on Ovariectomized Rats of Progesterone Alone and in Combination with the other Sexual Hormones

AN experiment on ovariectomized rats in relation to this question has been performed by Selye, Browne and Collip (1936)[1]. They obtained progestational changes in the uterus and vagina of four out of six rats injected daily for 19 days with 30 γ of œstrone and 400 γ of progesterone.

We performed our experiments on 101 ovariectomized rats, which were injected with progesterone alone (up to 500 γ daily) or in various combinations with œstrone (the dose of œstrone varying from 1 γ three times a week to 30 γ daily) or œstradiol (30 γ daily or three times a week). The dose of progesterone used in these combinations varied from 500 γ to 3000 γ daily. Preliminary injections of 6 γ of œstrone were given four times a week for 10 days before the first progesterone injection was added. The period of injection was usually 20 days or, in a few experiments, 27 days.

The injection of progesterone alone (500 γ a day) brought about only a slight hypertrophy of the uterine epithelium and an occasional cystic mucification of some of the cells of the vaginal epithelium. The uterus and vagina remained atrophic, the average increase in weight being very small.

With the combined injections with œstrone or œstradiol, the nearest approach histologically to the picture of the normal pregnancy uterus and vagina was obtained by the use of 1 γ of œstrone three times a week with 1,500 γ of progesterone daily. Increasing the dose of œstrone, even to only 6 γ, or decreasing the dose of progesterone, resulted in a decrease or, with some doses, even in the disappearance of the progestational changes, especially those in the uterus. Even the combination of 30 γ of œstradiol three times a week with 3,000 γ of progesterone daily (that is, increasing both doses simultaneously) gave uterine progestational changes which were less than those obtained with the first combination 1 γ : 1,500 γ.

While, however, with some of the combinations mentioned above the histological structure of the uterus and vagina showed typical progestational changes, both the size and weight of these organs with all doses were considerably less than those during pregnancy (the sterile horn of a pregnant rat was used for the comparison of the uterine changes). In fact, the uterus was even much smaller than that of the normal rat in dicestrus.

We have shown previously[2] that the so-called 'male' hormones, especially testosterone and testosterone propionate, when combined with œstrone, produce progestation-like changes in the sexual organs of ovariectomized rats, while at the same time these organs hypertrophy considerably. It is also known that the male sexual hormones (not identified) are present in the female organism. Taking these facts into consideration, various doses and combinations of testosterone, testosterone propionate and Δ^4-androstenedione (150–500 γ daily) were added to the combination of progesterone and œstrone. A considerably improved general development was obtained in the uterus and vagina which, with some combinations of the hormones, approached that seen in pregnant animals. The myometrium considerably increased. The progestational changes in the mucosa, however, decreased somewhat after these additions.

The nearest approach to the 'pregnant' uterus and vagina was obtained in most of the rats injected with the following combinations and doses:

(1) test. prop. 300 γ + prog. 2,000 γ + œstrone 6 γ;
or (2) test. prop. 500 γ + prog. 500 γ + œstrone 6 γ;
or (3) testosterone 500 γ + prog. 1,500 γ + œstrone 1 γ;
or (4) testosterone 500 γ + prog. 500 γ + androstenedione 500 γ + œstrone 6 γ.

We wish to express our gratitude to Prof. W. Schoeller and Messrs. Schering, Ltd., for kindly supplying us with progesterone, to Messrs. Ciba, Ltd., in particular to Dr. K. Miescher, for the supply of testosterone, testosterone propionate and androstenedione, and to Prof. A. Girard for œstrone and œstradiol.

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[2] Korenchevsky and co-workers, NATURE, **135**, 434; **136**, 185 (1935); **137**, 494 (1936). *Biochem. J.*, **29**, 2534 (1935); **30**, 558 and 1514 (1936); **31**, 467, 475 and 780 (1937). *J. Path. and Bact.*, **42**, 91 and 345 (1936).

Excretion of Nitrogen by Leguminous Plants

SINCE 1927, Virtanen and co-workers[1] have published results of numerous experiments which confirm and greatly extend the observation of Lipman[2] that certain leguminous plants when fixing nitrogen excrete part of this into the quartz sand subtrate, and if a non-leguminous plant is present, it may utilize the excreted form. The extensive data compiled by Virtanen and collaborators prove definitely that true excretion occurs with several of the legumes, but there exists an equally impressive body of experimental data which demonstrates conclusively that excretion is not *universally* obtained.

The original experiments of Lipman included only twenty-six cultures free of combined nitrogen thus capable of supplying clear-cut evidence. With respect to excretion, six of these were positive and twenty were negative. Examination of Stalling's data[3] shows no evidence of benefit to wheat when grown with soy beans. Ludwig and Allison[4] report no excretion with cow-pea, lucerne, vetch and sweet pea, as does Bond[5] with soy bean.

Since 1933 we have studied this problem using in most of our experiments a pea-oat mixture, but in certain ones lucerne, soy beans and red clover were included. In fifteen experiments, more than two hundred plant cultures grown under a wide range of experimental conditions have been examined, but in no case has excretion been detected either by benefit to non-legume in association or through analysis of the sand.

At the invitation of Prof. Virtanen and with the aid of Dr. S. v. Hausen, I conducted experiments at the Biochemical Institute in Helsingfors during the fall of 1936. In spite of unfavourable weather, which restricted nitrogen fixation, definite evidence of excretion was obtained with peas grown in sterile containers. The experiments were repeated this spring at Madison under identical conditions with the exception of the sand used—and of necessity with different environmental conditions, for example, type of greenhouse and weather conditions. In these experiments, excretion has been detected in *part*, but not *all*, the cultures independent of the quantity of nitrogen fixed. The cause of the discrepancies is not readily apparent, but the chief factor in associated cultures appears to be the manner of development of the plants. Our experiments indicate that excretion may be profoundly affected both qualitatively and quantitatively by the species of plant, nature of substrate and in associated cultures by the relative rate of growth of the different species. An environment that delays the reproductive stage appears to favour the excretion process.

Without minimizing the importance of Prof. Virtanen's studies, especially as they relate to the chemical nature of the excreted compounds, it is emphasized that excretion of nitrogen by leguminous plants is not universally obtained, even under experimental conditions which are apparently identical. For this reason the questions as to whether the phenomenon actually occurs in the field and to what extent it is responsible for the beneficial effects of associated culture of legumes and non-legumes remain unanswered. Until the factors which control the process are defined and the origin of the discrepancies known, it should be recognized that application to practical agriculture is only an attractive possibility and not an established fact.

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Succession of Broods of *Lebistes*

THERE seems to be a point in the natural history of *Lebistes* which is not generally known among those using this fish as a 'laboratory animal' in Great Britain. As it affects certain types of research very markedly, the following information will be of interest to those using this fish.

As a result of one mating, a female *Lebistes* may produce a succession of broods over a period of from six to eight months. From personal experience, I cannot vouch for the length of time mentioned (my authorities are Mellen and Lanier) as I am only now in the process of testing it, but that spermatozoa do remain alive within the body of the female and fertilise one brood after another is definitely established. The exact details of my data may be of interest. Mr. Gillespie sent me up some specimens from the Zoological Society of Scotland's Aquarium on February 3 last. As a result of the rigours of the journey, all were dead by the morning of February 5 except two females. Hoping for the best, I got no more, and one of the two, which has had no other companion except the other original one since, has produced the following broods: February 22, 3; March 28, 29; April 25, 58; May 27, 28. Judging from her present appearance, she is again an expectant mother!

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Method for Fixing Neutral-red in Supra-vital Stained Blood Smears

IN blood smears from horses stained according to the ordinary methods Giemsa and May-Grünewald Giemsa, we encounter serious difficulties in the examination: first, to differentiate between large lymphocytes and small monocytes, secondly, to determine *qualitative* changes in the white blood corpuscles. In order to remedy this, we have employed as a supplementary method, in an extensive investigation into the white blood picture in the case of infectious anæmia in horses, supra-vital staining with neutral-red.

We mix in a test-tube neutral-red with citrate blood at body temperature in the ratio of 1 : 15,000. The test-tube is placed in a thermostat at 37° for 40 minutes. In the meantime, it is shaken up a couple of times. After that we make an ordinary cover-glass smear, allow it to dry in the air for 24 hours, *fix it with a saturated picric acid solution*, and then stain it with Mayer's hæmalin (that is, Mayer's original recipe without citric acid), and embed in cedar oil.

In this slide thus prepared from *normal* horses, there is a large granulated deposit of neutral-red in monocytes, eosinophiles and basophiles, while no neutral-red grains are discovered in neutrophiles and lymphocytes. The difference between the neutral-red in lymphocytes and monocytes makes differentiation easy. In slides from horses *suffering from infectious anæmia*, there occurs during an attack of fever a more or less large deposit of neutral-red also in the neutrophiles. It is often connected with degenerative changes. The degeneration is demonstrated by vacuoles in the protoplasm and karyopyknosis with strong lobation of the nucleus. We have been unable to discover in the sick horses any changes in the amount of neutral-red deposit in the other white corpuscles.

This method does not, of course, present any opportunity for the study of the live white corpuscles as does the method described by Simpson[1] and by Sabin[2], but in contradistinction to the latter it makes it possible to study the cells at leisure when fixation of neutral-red has been reached. The nuclear staining also largely facilitates the investigation. A great advantage is also the possibilities it presents in the study of qualitative changes in the neutrophile leucocytes.

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Heterogeneous Equilibria with Deuterium

THE heterogeneous equilibria between hydrogen and the metallic chlorides have been extensively studied, notably by Berger and Crut[1] using a static method, and by Jellinek and his collaborators[2] using a dynamic method. More recently, Kapustinsky[3] has studied the reduction of cuprous chloride with both hydrogen and deuterium, using a static method. The agreement among the results of different authors is not very satisfactory and we are engaged in further investigations of heterogeneous equilibria involving hydrogen and deuterium.

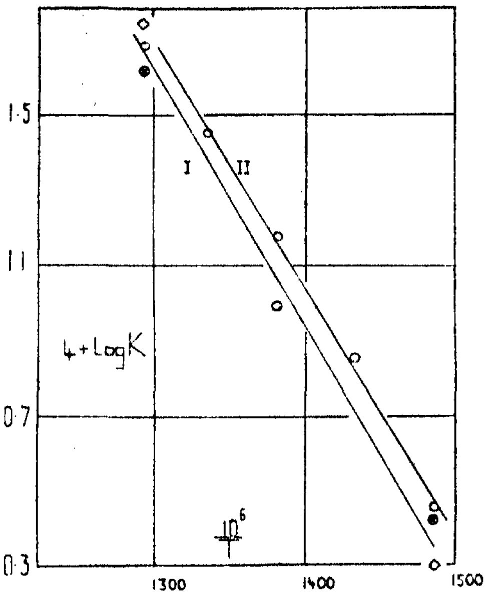

Fig. 1.

GRAPH I FOR HYDROGEN ; GRAPH II FOR DEUTERIUM.

⊗, PARTINGTON AND TOWNDROW. (H_2)
○, ,, ,, ,, (D_2)
◇, JELLINEK AND ULOTH. (H_2)

TABLE I.

	$H_2 + CoCl_2$			$D_2 + CoCl_2$				
T°	673	723	773	673	698	723	748	773
$10^6/T$	1486	1383	1294	1486	1433	1383	1337	1294
4 + log K	0·413 P. & T. 0·295 J. & U.	0·990 P. & T.	1·621 P. & T. 1·749 J. & U.	0·447	0·854	1·179	1·456	1·685

A static method has been used to study the reduction of cobalt chloride by hydrogen and deuterium. The cobalt chloride is heated with the gas at constant volume, the temperature being measured by a thermocouple, and pressure by a mercury manometer. The extent of the reaction is deduced from the increase of pressure due to the reactions :

$$CoCl_2 + H_2(D_2) = Co + 2HCl\ (2DCl)$$

The values of the equilibrium constant

$$K = C^2_{HCl}/C_{H_2}$$

obtained for hydrogen are in good agreement with those found by Jellinek and Uloth by a different method.

Table I shows the values of the equilibrium constant for hydrogen and deuterium at various temperatures. In Fig. 1 the logarithm of K is plotted against $1/T$, where T is the absolute temperature at which K is measured.

If K_1, K_2 are the equilibrium constants for the reactions :

$$CoCl_2 + H_2 = 2HCl + Co \quad . \quad . \quad . \quad (1)$$

$$CoCl_2 + D_2 = 2DCl + Co, \quad . \quad . \quad . \quad (2)$$

respectively, then $K^* = K_1/K_2$ is the equilibrium constant for the homogeneous reaction :

$$2DCl + H_2 = 2HCl + D_2, \quad . \quad . \quad (3)$$

namely, $K^* = C_{D_2} \cdot C^2_{HCl}/C_{H_2} \cdot C^2_{DCl}$

Urey and Rittenberg[4] have calculated values of K^* at different temperatures on theoretical grounds. These are compared in Table II with values obtained experimentally by Kapustinsky and ourselves.

TABLE II.

	1 + log K^*				
T°	769	700	690	658	575
Urey and Rittenberg	0·96	0·94	—	—	0·91
Kapustinsky	—	—	0·78	0·70	—
Partington and Towndrow	0·92	0·89	—	—	—

The heats of reaction ($Q_v = \Delta U$) of reactions (1) and (2) above are deduced from graphs I and II to be −31,850 gm. cal./mol and −30,790 gm. cal./mol respectively, at a mean temperature of 450° C. The value given in the International Critical Tables for reaction (1) is −32,360 gm. cal./mol at 18° C. (determined thermochemically).

On plotting log K^* against $1/T$ a straight line is obtained from which the heat of reaction (3) is deduced to be −1,100 gm. cal./mol.

As would be expected from theoretical considerations, the value of K^* tends towards unity with increasing temperature, and the difference from unity may be shown to be negligibly small at 800° C.

The investigation is being extended to other types of reaction.

J. R. PARTINGTON.
R. P. TOWNDROW.

Queen Mary College,
London. June 14.

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[1] Berger and Crut, *C. R.*, **173**, 977 (1921).

[2] Jellinek and Uloth, *Z. phys. Chem.*, **119**, 161 (1926) ; Jellinek and Rudat, *Z. phys. Chem.*, **143**, 244 (1929).

[3] Kapustinsky, *J. Amer. Chem. Soc.*, **58**, 460 (1936).

[4] Urey and Rittenberg, *J. Chem. Phys.*, 1, 142 (1933).

The Corona by Reflection from the Moon

THE light from the photosphere of the sun will illuminate not only the hemisphere of the moon facing the sun but also a zone five miles wide beyond the great circle bounding the hemisphere. A further zone five miles in width will be illuminated by those radiations emanating from the corona, if the height of the corona be regarded as equal to one radius of the sun. The intenser light of the relatively low inner corona will fall on a narrow strip of this lunar zone, bordering upon the edge of the surface upon which the photospheric light is falling.

Let the slit of a spectrograph be placed across the illuminated portion of the moon's surface so that half the slit is projecting over the apparently unilluminated lunar surface. It will thus cross this five mile zone, which will be reflecting corona light. The spectrogram should reveal first a strip of the usual reflected sunlight; then, theoretically, the emission lines of the high chromosphere; and then the typical corona spectrum.

The practical difficulties involved are the very long exposure times which would be required to gather sufficient reflected corona light to give the image, and the very exacting requirements of guiding.

If one of the powerful long-focus telescopes were used for this investigation, and a 15-inch image of the moon were formed at the plane of the slit, then a five-mile strip of the moon's surface would be 0·95 mm. at the slit. Hence the need for very accurate guiding is obvious, so that the edge of photospheric illumination will not encroach upon this critical millimetre of the slit.

Since earthshine is strongest upon the moon during its early phase, this would not be a good time, but at and near half moon would seem to be the most favourable period.

In Fig. 1, *AM* is the radius of the sun; *MN* indicates the region of the corona; *B* is the moon; *PEM* is tangent to both moon and sun, and *QFN* is tangent to moon and corona. Thus *EG* bounds the photospherically illuminated portion of the moon, while *EG* and *HF* define the zone illuminated only by coronal light. Obviously this narrow strip of the moon's surface presents the largest target as viewed from the earth at first and third quarter.

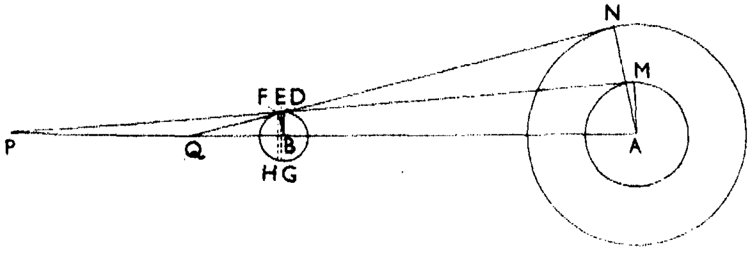

Fig. 1.

The director of Mount Wilson Observatory has expressed his interest in this proposed method of investigating the corona, and suggests the desirability of having the method tried out at more than one observatory.

A. VIBERT DOUGLAS.

McGill University,
Montreal.
May 11.

Viscosity of Binary Mixtures

THE equation[1]

$$\log \eta = N_1 \log \eta_1 + N_2 \log \eta_2 \qquad (1)$$

which is advanced by Dr. Lederer to give η, the viscosity of an ideal binary mixture, assumes that N_1 and N_2 are the physical molecular weights of the liquids 1 and 2 the viscosities of which are respectively η_1 and η_2.

Now, if S_1 and S_2 are the association factors for the respective liquids, then the relation between m_1 and m_2, the chemical molecular fractions of the liquids, and N_1 and N_2 is:

$$N_1 = \frac{m_1/S_1}{m_1/S_1 + m_2/S_2} = \frac{m_1 S_2}{m_1 S_2 + m_2 S_1} \qquad (2)$$

$$= \frac{m_1}{m_1 + m_2 S_1/S_2}$$

If $S = S_1/S_2$,
then

$$N_1 = \frac{m_1}{m_1 + m_2 S} \text{ and } N_2 = \frac{m_2 S}{m_1 + m_2 S} \qquad (3)$$

S in equation (3) is, therefore, the ratio of the association factors of the liquids 1 and 2, respectively.

In Dr. Lederer's communication[1] the factor S is defined as the degree of association of component 2, but it would appear more correct to define S as the ratio of the association factors as derived in (3) above.

A further matter of interest is that the value of S varies (for the system benzyl benzoate in toluol at 25° C.—Kendall and Munroe's data) by 4 per cent about the mean value, as shown in the accompanying table.

m_1	$S = S_1/S_2$	
0·2367	0·805	
0·4261	0·818	
0·6502	0·840	Mean value 0·836
0·7890	0·862	
0·9002	0·860	

m_1 is the chemical molecular fraction of benzyl benzoate in toluol taken from Kendall and Munroe's data. Kendall and Munroe, however, showed that the freezing point data of solutions of benzyl benzoate in toluol were normal, whence S_1 = unity; hence the *average* value of S_2 = 1·197, that is, the average degree of association of *toluol* is 1·197 in this solution. Dr. Lederer referred the value 1·197 to benzyl benzoate as an association factor, and in so doing appears to be in error.

It may be observed that an excellent test for the veracity of equation (1) above would be provided by an ideal binary mixture of components of approximately equal viscosity characteristic, because it is clear from relation (1) that if $\eta_1 = \eta_2$, then $\eta = \eta_1 = \eta_2$. Such a mixture should, of course, show no heat effects on mixing and have the general characteristics which guided Kendall and Munroe in accepting benzyl benzoate in toluol as an ideal mixture. An approximate test obtains with the system propyl acetate + benzol—a system showing but a small heat effect on mixing—and, in this case, the value η is less than η_1 or η_2, whence equation (1) cannot apply. Dr. Lederer's fundamental equation

$$\log \eta = m_1 \log \eta_1 + m_2 \log \eta_2 - \int \frac{qm}{4{\cdot}577T^2}, \qquad (4)$$

however, provides for such cases where the integral involving the molecular heat of solution qm must be evaluated.

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Stowmarket,
Suffolk.

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[1] NATURE, 139, 27 (1937).

Use of the Word Substrate

IN recent years, the practice has grown up among workers in surface chemistry of using the word 'substrate' to denote the bulk phase underlying a surface film, regardless of the fact that this word has been in general use for a much longer time to denote the substance upon which an enzyme acts. The name as applied to a bulk phase on which a surface film rests would seem harmless enough in most cases, but since it is almost certain that, in enzyme action, the substance acted on is adsorbed, probably locally and one molecule thick, on the surface of the enzyme, the same word 'substrate' will have to do duty *both* for the underlying, and more bulky, enzyme, *and* for the small molecules upon which the enzyme acts!

If the words 'subtratum', or 'underlying liquid' (or solid, as the case may be) were used instead of substrate for the denser phase adjoining a surface film, I think this inconsistency, and possible source of confusion, in nomenclature, would be simply avoided.

N. K. ADAM.

Sir William Ramsay Laboratories of
Physical and Inorganic Chemistry,
University College,
London, W.C.1.
July 1.

Points from Foregoing Letters

THE isotopic and packing fraction of krypton atoms of mass 78, 82, 84, 86, and of xenon atoms of mass 129, have been determined by Dr. F. W. Aston, by comparison with hydrocarbon 'doublets', by means of the mass spectrograph.

Dr. D. Crowfoot reports that the birefringent insulin crystals of prismatic type obtained by crystallization from acetate buffers at *p*H 5·2 gives similar X-ray patterns to those shown by the usual rhombohedral form, except for a more marked diffuse ring which may be due to the prevalence of amorphous matter, probably responsible for the prismatic form.

The probable absolute configuration of the naturally occurring α amino-acids has been demonstrated by R. C. Rainey by the application of Boys's rule to 2-amino-hexane, the configuration of which has recently been correlated with that of the amino-acids by Levene and Mardashew; solvent action prevents the direct application of the rule to the amino-acids themselves.

Dr. St. Ziemecki, by replacing argon in a pressure ionization chamber for cosmic ray measurements by krypton, finds the effect was an increase of the ionization current, which was approximately 2·7 times greater than with argon at the same pressure. Thus by using krypton-filled chambers, it is possible to reduce greatly the pressure employed and hence the weight of the apparatus, which is of importance in measurements in high regions of the atmosphere.

By applying a number of corrections (due to mass-polarization, relativistic change of mass with velocity, magnetic interaction between the orbits, etc.) to the calculated value of the ionization potential of lithium atoms, H. A. S. Eriksson finds a value of 610,100 cm.$^{-1}$ in fair agreement with the experimental value. For helium, the agreement is not so good. Theoretical values are somewhat higher than experimental ones.

A band in the region of 3000 A. of the Raman spectra of several inorganic acids observed by Dr. C. S. Venkateswaran is attributed by him to the presence of the OH group. The author gives a table showing the frequency limits of the bands in the cases of sulphuric, iodic, selenious, telluric and boric acids and, from their broad and diffuse nature, deduces that the OH group, though present in these acids, is much weaker in strength than the OH group present in the alkalis.

The surface migration of barium on to the opposite side of nickel and tungsten ribbon used in thermionic emission valves, as reported by J. A. Becker, is not confirmed by Dr. M. Benjamin and R. O. Jenkins, even after sixteen hours running at 1,100° K.

Prof. S. S. Bhatnagar, Dr. H. Lessheim, and Mohan Lal Khanna find that the diatomic vapour of selenium is paramagnetic, which fact agrees with the view that the ground[1] level of Se_2 is $^3\Sigma$.

Experiments on animals are described by Dr. P. J. Du Toit and A. I. Malan to show that rickets result from a deficiency of phosphorus, even in the presence of vitamin D. Lack of calcium, on the other hand, leads to osteofibrosis.

Dr. V. Korenchevsky and K. Hall find that suitable combination of female and male sex hormones (progesterone, œstrone, testosterone and androstenedione) bring about normal pregnancy changes in the uterus and vagina of ovariectomized rats.

Prof. P. W. Wilson describes experiments made at Helsingfors, Finland, and others at Madison, U.S.A., in which both positive and negative results with respect to excretion of nitrogen by leguminous plants were obtained. He emphasizes that the existence of these negative findings together with the lack of clear definition of the conditions required for the occurrence of the phenomenon, make it impossible to decide at this time if the excretion plays a significant part in Nature.

The case of a female *Lebistes* (the 'millions' fish which devours mosquito larvæ) which, as a result of a single mating has produced a succession of broods over a period of several months, is reported by G. L. Purser.

A method of staining smears with neutral-red, enabling one to differentiate between lymph-cells and small monocytes and to indicate qualitative changes in the white blood corpuscles (in infectious anæmia in horses) is described by A. Hjärre and H. Berthelsen.

The equilibria between cobalt chloride, and hydrogen and deuterium have been studied by Prof. J. R. Partington and R. P. Towndrow. Values of the equilibrium constant have been obtained at different temperatures, and from these the heats of reaction have been calculated.

ERRATUM.—Referring to his letter entitled "Collision of Two Oil Drops and the Stability of a Non-spherical Oil Drop", which appeared in NATURE of July 10, p. 70, Mr. Yoshio Ishida writes that owing to an error in the manuscript, 'oblate' should read 'prolate', and vice versa.

Research Items

Votive Offerings from Chichen Itza, Yucatan

ACCORDING to a recent announcement of the Carnegie Institution of Washington, D.C., some remarkable votive or possibly foundation offerings were found in the course of recent excavations at Chichen Itza, the famous city of the New Empire of the Maya of Yucatan, which flourished from the middle of the eleventh century of our era almost down to the coming of Columbus and the time of the Spanish conquest. The Carnegie Institution, which is working in co-operation with the Bureau of Pre-Hispanic Monuments of the Mexican Government, has been engaged in the exploration of El Castillo, the pyramid temple of the Maya god Kukulcan. This temple, built on top of a pyramidal structure, encloses completely, it has been found, an earlier temple and pyramid—a method of construction followed elsewhere in Yucatan. Excavation for the purpose of exploring the inner temple has led to some remarkable discoveries. In 1935, for example, a rectangular treasure box of limestone was found at the foot of a stairway. Its lid was a single stone, two and a half feet long by two feet wide. Among its contents were two turquoise mosaic plaques of great beauty, necklaces of coral, turquoise and jade, carved jade beads and pendants, and about 2,000 loose button-shaped beads of turquoise. The later find, made last season, was even more remarkable. In the inner chamber of the buried temple, of which the back wall was studded with the heads of human femora, presumably from sacrificial victims, there was found another box of squared limestone blocks, inside which was a throne fashioned from a single block of stone carved to represent a jaguar and painted a vivid red. The spots of the jaguar are represented by inlays of apple-green jade. The eyes are large hemispherical pieces of jade, the teeth and fangs of hard white stone. Its greatest length is two and three quarter feet, its greatest height to the top of the head, two and a quarter feet. Resting on the jaguar were a turquoise mosaic plaque, a shell necklace and a carved jade pendant. With much wisdom and judgment, the Mexican Government has decided that these finds shall remain *in situ* for the inspection of students and visitors.

Population Study of the Song Sparrow

MARGARET M. NICE has published a study, which extended over eight years, of a song sparrow population ("Studies in the Life History of the Song Sparrow 1. A Population Study of the Song Sparrow", *Trans. Linn. Soc. New York*, 4, April 1937. 1 dollar 50 cents). Each adult bird was marked individually with coloured bands. The various aspects of the life-history are clearly set out, from which a selection follows. The bird is a partial migrant at Cleveland, Ohio. About half the nesting males are resident, about half migrate. Of the females, only a tenth to a third are resident. A few individuals of both sexes changed status in different years. There was no evidence that the males with the larger territories, more vigorous song or brighter plumage, were more successful than their fellows in obtaining mates. There is not, apparently, a reservoir of unmated birds of either sex to fill gaps due to mortality in the breeding season. The influence of warm waves of temperature on the commencement of song, migration and egg-laying is observed, and graphs show that the temperature-threshold at which each occurs is different at different times of year. Young often settled near their parents' territories, of which detailed genealogies are given, and one brother and sister mated. There is a detailed analysis of nesting success and survival of young and adults, and in a discussion of population limitation the importance of local changes in the environment is stressed. Territorial behaviour is considered to prevent overcrowding. There is also detailed information on weight, eggs, feeding times and other aspects of the breeding biology, and one chapter discusses the habits of the parasitic cow-bird. This is an important monograph, and the Linnean Society of New York has rendered a real service to ornithology by publishing it at such a moderate price.

Pituitary Extracts and Gastric Ulcers

A SERIES of papers by Prof. E. C. Dodds, working with various collaborators (*Proc. Roy. Soc.*, B, **123**, 22; 1937), gives a full account of some interesting observations on the effect of extracts of pituitary on the stomach. It has been found that extracts of the posterior pituitary containing the pressor principle produce gastric ulcers when injected in large doses into various animals. This observation provides a new way of studying methods of treating gastric ulcers. The production of ulcers appears to be due to the fact that the extracts inhibit gastric secretion, whether this secretion is due to histamine, insulin, sham feeding or pilocarpine. The action is primarily on the volume of the juice secreted. A continuous secretion of juice is probably necessary to protect the mucous membrane. A method is described for recording the gastric secretion and the blood flow simultaneously in an anæsthetized cat's stomach. Stimuli causing secretion induce increased blood flow and if the increase in blood flow is prevented, secretion does not occur. The injection of pituitary extracts inhibits both blood flow and secretion. In normal animals blood flow and secretion are closely co-ordinated, but after hypophysectomy this co-ordination disappears. The possible significance of these results is widened by the observation that pituitary extracts have a similar action on pancreatic secretion. These facts are possibly related to the action of these extracts on the excretion of urine.

Early History of the Potato

DR. R. N. SALAMAN delivered the Masters Lectures of the Royal Horticultural Society last autumn, on "The Potato in its Early Home and its Introduction into Europe" (*J. Roy. Hort. Soc.*, **62**, Parts 2, 3, 4 and 6; 1937). A mass of archæological material has been marshalled to show that the potato was cultivated in South America at least so early as A.D. 200. Many representations of the tuber as a motif for the pottery of several epochs of South American history are illustrated, and show that the life of the Indian was closely linked with this plant.

Dr. Salaman also shows that the potato satisfied the conditions demanded by the physical setting of the Inca civilization, and provided a supply of food where the cereal grains failed. He agrees with Vavilov, Bukasov and other Russian investigators, that potato cultivation originated in two distinct areas—in the plateaux of Peru and Bolivia, and in Chile and the island of Chiloe. The Russians believe, on botanical grounds, that the southern focus of development supplied the ancestry of our present-day 'Irish' potato; but Dr. Salaman, using arguments provided by history, believes that the Peru-Bolivian source is much more likely. The potato entered Europe by two channels, namely, by way of England, and via Spain. Introduction into England, according to Dr. Salaman, cannot be readily dissociated from the names of Drake and Raleigh, in spite of the modern tendency to deprive these gentlemen of the honourable place in horticulture which tradition assigns to them. Dr. Salaman has ante-dated the first record of potato culture in Europe by fifteen years, with his proof that tubers were grown in the neighbourhood of Seville in 1572. He has also established the documented history of the crop for a very early period.

Fault-movements and the Safety of Reservoir Dams

IN searching for reservoir sites among the coast ranges of California, engineers have found the most satisfactory features in certain fault-line valleys. The major faults of the district—the San Andreas, Hayward and Calaveras faults—have made possible the development of longitudinal valleys along parts of their courses, valleys so narrow that they can be closed by dams of moderate length. Dams have, indeed, been made across each of the three faults mentioned, and the question has been asked: Can a safe dam be built in a fault-line valley of a presumably active fault? Mr. G. D. Louderback has endeavoured to answer the question and to state the conditions that should be satisfied in their construction (*Bull. Seis. Soc. America*, **27**, 1–27; 1937). He shows how the activity of a fault may be determined by mapping the epicentres of recurring small earthquakes, and the map given of the three faults with the centres of the earthquakes of the years 1932–35 clustered along a great part of the course of each, reveals that they are all definitely active faults. The experience of past earthquakes makes it clear that provision must be made for a horizontal displacement of 15–20 ft. and a vertical one of 5–10 ft. The dam should therefore be 60 ft. wide at the crest with slopes of about 2 : 1. To avoid fracture, outlet pipes should be laid parallel to the active fault. Lastly, the dam and all its subsidiary structures should be built so as to resist a strong shock and also the effects of slumping and landsliding.

A Coefficient of Humidity

AMONG the series of papers of the State Meteorological and Hydrological Institute of Sweden is one (No. 11) entitled "A Coefficient of Humidity of General Applicability", by Anders Angström, which sets out certain ideas that were first discussed at the 1936 meeting at Edinburgh of the Union for Geodesy and Geophysics. The author points out the desirability of having some function which will indicate the humidity or aridity of any climate in respect of the soil, that is, which will take into account both the rainfall and the evaporation. A function of this kind was used by Lang in 1920, who took simply the ratio of the annual precipitation to the sum of the mean temperatures of the frost-free months divided by twelve, while Martonne in 1926 took the ratio of the annual precipitation to $10 + T$, where T is the annual mean temperature (in each of these two cases temperature is measured in centigrade). Angström suggests an alternative function, having the advantage over the two cited that it is a continuous function of temperature and can be used in the study of arctic climates. It is represented by the expression $1{\cdot}07^{-t}$, where t is the mean temperature. He finds that this function is closely proportional to the mean duration of precipitation for a month if the latter is measured in hundreds of minutes, and that it is very nearly equal to the humidity function of Martonne for monthly mean temperatures between 0° C. and 20° C. A table is given which enables the new function to be read off quickly in terms of t, and two maps show its distribution in January and July over north-west Europe and adjacent polar regions, including Iceland, Greenland and Spitsbergen.

Monomolecular Films

THE study of the orientation of the molecules in monomolecular films has become of such importance that Messrs. E. Havinga and J. de Wael, of the van 't Hoff laboratory of the University of Utrecht, have worked out a technique for the production and investigation of such films by electron diffraction methods, and have published an account of it in the issue of March 15 of *Recueil des Travaux chimiques des Pays-Bas*. The film in the case described was of barium stearate prepared on the clean surface of water and floated by lowering the water slowly on to a thin solid film of nitro-cellulose or of gold leaf placed below the surface of the water. The film of nitro-cellulose itself was prepared by placing a drop of a solution of nitro-cellulose in amyl acetate on a clean water surface. On evaporation of the solvent, a film of about 300 A. thick was produced. An electron tube producing electrons of about 40 kilovolts path was used, and it was found that in addition to the diffraction pattern due to the support, in each case a hexagonal pattern of spots was produced which is attributed to the barium stearite film. Full details of the most suitable technique are given.

Two Visual Binary Orbits

DR. R. v. d. R. WOOLLEY and L. S. T. Symms have recently published a paper in which they discuss the orbits of O Σ 38 (γ_2 Andromedæ) and β 101 9 Argus (*Mon. Not. Roy. Astro. Soc.*, **97**, 6; April 1937). Both stars have completed at least one revolution, so that the periods can be determined with considerable accuracy. Orbits have been already published, and those given by the authors have been obtained by applying differential corrections to previous orbits. A description of the method for applying these corrections is given in each case. The ephemeris for the first binary shows a very small separation near periastron, and micrometer measures here would be useless. It is suggested that an interferometer might be used in 1946–47 when the separation is $0''{\cdot}02$–$0''{\cdot}03$, as the star is bright. The period is 56 years (a year greater than the period found by Hussey), the eccentricity and inclination being 0·92 and 109·2° respectively. In the case of β 101, the eccentricity and inclination are also high, the values being 0·69 and 77·8° respectively. The period of this binary is 23·18 years.

Growth Factors

A DISCUSSION meeting on "Growth Factors" took place at the Royal Society on Thursday, June 24. The discussion revealed the emergence of a line of biochemical application which hitherto has been obscured by the diversity of its interest.

For a number of years, sporadic reports have been published by workers in the fermentation industries and bacteriology that the growth of yeast and bacteria depends not only on the provision in the diet of gross sources of energy and nitrogen, but also upon illusive materials—'bios', 'accessory growth factors', akin to the 'vitamins', responsible for the functioning of special phases of animal metabolism or even for the growth of animals. More recently, these tentative findings have been reinforced by workers in other specialized fields, for example, in botany and protozoology, and, by the use of modern biochemical technique and knowledge, it would now appear that the case established in the nutrition of animals is equally established in the nutrition of the most diverse varieties of cells; namely, that all cells from the lowliest bacterium to the cells of the highest animals are enabled to carry out the series of reactions between the sources of energy and nitrogen, which result in the production of energy and growth, only by the agency of other substances mostly of a nature akin to those already described in animal metabolism—vitamins. The only notable difference between the various forms of life is that these accessory substances are normally synthesized by some cells but not by others, and thus in the former case these substances need not be supplied in the nutrient diet.

The proceedings were opened by Prof. F. Kögl, of Utrecht, with a review of the present state of knowledge of the plant hormones, auxin *-a* and *-b* and heteroauxin (β-indolylacetic acid). The auxins were first thought to exert their effect on cell elongation, but now it is recognized that they regulate plant growth in many ways. Auxin-*a*, for example, is thought to account for the phenomenon of phototropism. Auxin-*a* lactone loses its activity under the action of ultra-violet light, and thus the shaded side, containing a greater concentration of activity, would elongate and produce the effect of phototropism. The action of heteroauxin seems to be primarily associated with the formation of roots on stem cuttings. This action is, however, not dependent on chemical structure, since a number of unrelated substances have a similar effect, recalling the non-specificity of œstrogenic compounds described by Dodds and co-workers.

Prof. Kögl also gave an account of his 'biotin', a sulphur-containing substance of great potency which may be the chief component of 'bios', originally described by Wildiers as a necessary growth factor for yeast. Biotin has also been shown to have an effect on the growth of higher plants.

Dr. P. Fildes (London) reviewed the subject as it appears to the medical bacteriologist, tracing the evolution of the vitamin concept for bacteria from Twort and Ingram's growth factor for Johne's bacillus (1912) to the present time, when vitamin B_1 has been proved to be essential for *Staphylococcus* and propionic acid bacteria, and nicotinic acid or cozymase for *Staphylococcus* and the influenza bacillus. He laid stress on the facility with which bacteria can adapt themselves to altered nutritional conditions, and ascribed the fact that parasitic bacteria specially require growth factors to a loss of synthetic function which has resulted from long association with an environment in which these factors are preformed. These dependent bacteria can readily be trained back to their 'original' state, in which they can synthesize the factors and so do not require to be supplied with them. In a series of different species of bacteria, each ultimately requiring cozymase for growth, it was shown that the complexity of the nutrients from which cozymase can be synthesized depends upon the synthetic power of the bacteria at the time of examination.

M. André Lwoff (Institut Pasteur, Paris) pointed out that certain bacteria and Protozoa cannot grow without a supply of hæmin, because they are unable to synthesize it from iron compounds in the nutrients. The importance of hæmin is ascribed to its function as a stage in the synthesis of cytochrome in Keilin's system. Its effect is to increase greatly the oxygen consumption of organisms starved of it.

M. and Mme. Lwoff have demonstrated that the long-known 'vitamin factor' of the influenza bacillus is none other than Harden and Young's cozymase or Warburg's co-enzyme. Metabolic studies have shown that cozymase acts as a codehydrogenase for various substrates and much increases the oxygen uptake of influenza bacilli and anaerobic glycolysis. Both hæmin and cozymase function as bacterial growth factors as components of the dehydrogenase-cytochrome system of Keilin and Warburg.

Mr. B. C. J. C. Knight (London) gave an account of the *Staphylococcus* and *Sporogenes* factors referred to by Dr. Fildes. He showed that the former consists of nicotinic acid, a constituent of cozymase and of the two halves of the vitamin B_1 molecule—the pyrimidine and thiazole rings. The activity of each compound depends strictly on certain chemical configurations. The *Sporogenes* factor has not been finally determined, but there is evidence that it may have a much wider importance than merely the regulation of the metabolism of the obligate anaerobes.

Dr. G. M. Richardson (London) described uracil, a component of nucleic acid, as an essential factor in the anaerobic growth of *Staphylococcus*. Uracil is synthesized by the organism aerobically, and therefore under these conditions its effect on growth cannot be demonstrated. Anaerobically, however, the synthetic power of the organism is sufficiently depressed to make the demonstration possible. No metabolic function has hitherto been ascribed to uracil.

In the discussion which followed the more formal proceedings, there appeared to be complete agreement between the various speakers not only in detail but also in the wider implications of the discussion. Dr. E. R. Holiday (London) referred to the demonstration of nicotinic acid in Knight's crude *Staphylococcus* factor by means of absorption spectra. M. Lwoff recalled other factors which have been found by his colleagues in the Pasteur Institute, namely, the forms of sulphur necessary for the growth of certain fungi (Volkonsky) and the sterols found by Mlle. Cailleau to be necessary for flagellates.

A Method of Determining Stellar Rotation*

WHILE rotational speeds of stars can be estimated from photographs of stellar spectra, the actual deduction of these speeds and the demonstration that the star is rotating depend on rather abstruse mathematical calculation which, however, leads to a comparatively simple working routine. A knowledge of stellar rotational speeds, while obviously worth determining in any event, has several immediate applications, such as assessing the age of the stellar system, and is especially important in discussing the state of affairs in stellar atmospheres, a high rotational speed tending to offset gravity and promote ionization. If the rotational speed of a star is determinable, then the 'proper' spectrum of the star can be deduced; that is, the light emitted by any element of the star's surface, as distinct from the 'integrated' spectrum directly observed. Owing to the minuteness of a stellar image in a telescope, the light from the whole of the star's surface passes into the spectroscope, and the rotational speed of a star cannot be measured as can that of the sun by observing the Doppler displacement of the Fraunhofer lines from one limb as compared with the other.

Prof. Carroll's method depends on the fact that the observed shape of a stellar absorption line (that is, the graph of intensity plotted against wavelength) has certain peculiarities if the star is rotating.

If a star be rotating, then different elements of area on the surface of the star are moving towards or away from the observer with velocities in the line of sight which depend on their position on the stellar surface and the rotational speed of the star. Thus, the spectra from the different elements do not simply superpose, as they would in a non-rotating star, but are displaced somewhat with respect to each other, thus resulting in a shallow broadened line. The final observed line shape therefore depends on two factors, namely, (*a*) the shape of the line emitted by any element of the star and (*b*) the rotational displacement. The first factor is quite unknown—previous methods of estimating stellar rotational speeds, however, depended on assuming this to be known—but the second factor can be detected by the new method.

The equations connecting the 'proper' shape $\mathfrak{I}(\mathfrak{T})$ of a line and the observed shape $\mathfrak{O}(\mathfrak{T})$ are

$$\mathfrak{O}(\mathfrak{T}) = \frac{1}{a}\int_{-1}^{+1} \mathfrak{I}(\mathfrak{T} + \beta t)\, g(t)\, dt$$

where a is a numerical factor and equal to $\int_{-1}^{+1} g(t)dt$, and $g(t)$ is a function that depends on the way the brightness of the star varies over its disk, and β is the rotational speed of the star.

The solution of this equation is[1]:

$$\mathfrak{I}(\mathfrak{T}) = \frac{1}{2\pi i}\int_{0}^{\infty} \frac{e^{-ux}}{G(\beta x)} \int_{c} \mathfrak{O}(z) e^{-zx}\, dz dx,$$

where $$G(u) = \frac{1}{a}\int_{-1}^{+1} e^{-ut}\, g(t)dt\,;$$

but this is unusable as it stands as $\mathfrak{O}(z)$ is to be integrated over a certain contour in the complex domain and $\mathfrak{O}(z)$ is only known for real values of z. Analytical investigation shows a simple way out. We form the real part of the Fourier transform of $\mathfrak{O}(\mathfrak{T})$, namely, $f(u) = \int_{-\infty}^{\infty} \mathfrak{O}(\mathfrak{T}) \cos u\mathfrak{T}\, d\mathfrak{T}$, which is easily done and plotted as a graph of $f(u)$ against u. It appears that, if the star be rotating, $f(u)$ must vanish (have zeros) at certain values of the product $u\beta$. Now we find, by plotting $f(u)$, the values of u for which $f(u)$ vanishes and hence by simple division the value of β.

It is, of course, possible for $f(u)$ to vanish for other reasons; the importance of the method lies in the fact that, if $f(u)$ has several zeros, they must give (or some of them), if the star is rotating, consistent values of β. A further test is that the values of β from different lines must be the same. Thus, if several zeros from several lines all yield substantially the same value for β, we can feel with some confidence that the observed line shapes are really produced by rotational broadening. As the theoretically calculated values of $u\beta$ for which $f(u)$ vanishes depend somewhat on the law of darkening involved in $g(t)$, it is theoretically possible to test this law as well. Having found β, a further simple computation (forming $\mathfrak{I}(\mathfrak{T})$ from its transform) yields the 'proper' shape of the emitted line.

A similar method can be applied to the problem of stellar expansion.

In interpretation of this procedure, it was explained that any arbitrary function of the type considered might be represented by a 'spectrum' of harmonic constituents (Fourier's integral theorem), the result obtained meaning that, if the observed line shape is due to rotation, certain of these harmonic constituents must necessarily be absent. Practical tests for this give the information (*a*) whether the star is rotating, (*b*) the speed of rotation, that is, the equatorial velocity in the line of sight, and (*c*) thus enabling the 'proper' shape of the lines in the stellar spectrum to be found.

Unfortunately, the lines to be examined are, if the rotational speed be high enough to be readily determinable, wide, faint, shallow lines, and the technique of stellar photographic spectrophotometry is strained to the uttermost in providing sufficiently accurate measurements of line shape. Prof. F. J. M. Stratton, of the Solar Physics Observatory, Cambridge, is collaborating with the Natural Philosophy Department of the University of Aberdeen in attempting to produce sufficiently good observations, and very promising results are now being obtained.

In the case of one star, namely, Algol, independent measurements of rotational speed are available, and the direct measurements give 26 km./sec. as the equatorial line of sight velocity for this star, compared to 26 ± 3 km./sec. determined by Prof. Carroll's method, using an exceptionally well determined profile of the line Mg^+ at 4481A. obtained by Struve at Yerkes Observatory.

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* Summary of a lecture on "Rotating Stars" delivered before the Newcastle-upon-Tyne Astronomical Society at Armstrong College, on March 11, by Prof. J. A. Carroll.

[1] *Mon. Not. Roy. Ast. Soc.*, **93**, 478, 508, 680 (1933).

Aluminium Manufacture in Great Britain

WITH the exception of silicon, aluminium is probably the most abundant metal in the world, forming nearly one eighth of the earth's crust. Owing to the ready manner with which it combines with oxygen, it is never found, as most other metals are, in the metallic state. In a paper in the 'Aluminium Section' of the March issue of the "Trade and Engineering Supplement" of *The Times*, Mr. W. Murray Morrison gives an outline of the position which the aluminium industry now occupies in the British Isles.

In 1921, the Lochaber Power Co. was formed and developed a large water-power station. When completed, this scheme will be capable of developing 100,000 h.p. continuously, and will be by far the largest hydro-electric development in Great Britain. The British Aluminium Co. operates three reduction works, at Foyers, Kinlochleven and Lochaber. These are supplied with pure aluminium oxide from their works at Larne in Ireland and Burntisland in Scotland. These works in turn are supplied with crude ore, bauxite, from the Company's own mines, vast deposits being owned by it in the south of France and in some British colonies. There is one other producer of the crude metal in Great Britain, namely, the Aluminium Corporation, the supplies of alumina for which are produced at Hebburn-on-Tyne and reduced to the metal at Dolgarrog, North Wales.

The final forms in which aluminium reaches the public cover a very wide field. The two forms in which it is best known are for cooking utensils and foil. The advantages of aluminium vessels for cooking are their lightness, cleanliness, hygienic qualities and heat conductivity, together with their immunity from chipping, rusting and burning; these properties have made them very popular. Aluminium foil has almost entirely replaced other kinds of metal foil and is adopted for the wrapping of cigarettes and chocolates, the capping of milk bottles and tea-chest linings.

In connexion with motor-cars, aluminium pistons are now very commonly employed. Aluminium, which is only one third the weight of iron or copper, made possible the remarkable increase in the speed of transport which has taken place during the last fifty years. Motor-vehicle owners are keenly alive to the fact that it costs a given sum to convey a given weight a given distance in a given time. There is an additional advantage of using aluminium in road vehicles, as the increased lightness sometimes saves an appreciable part of the motor tax in Great Britain and allows the vehicle to run at a higher speed.

In air transport, where lightness is a paramount consideration, aluminium and its alloys play a very important part. Only one metal lighter than aluminium, namely, magnesium, is used as the major constituent in the manufacture of light alloys. The production of magnesium is closely allied to the aluminium industry. For these two metals and their alloys the aircraft industry depends for many of its components.

In electrical transmission, aluminium has been most useful. In Great Britain, the transmission lines of the National Grid alone employ more than 20,000 miles of steel-cored aluminium cable.

Association for the Study of Systematics in Relation to General Biology

AN opening meeting of the "Association for the Study of Systematics in Relation to General Biology" was held in the rooms of the Linnean Society (by kind permission of the president and council) on Friday, June 25. The chairman of the Association, Dr. Julian Huxley, presided over a gathering of seventy-four biologists.

In his introductory remarks, Dr. Huxley outlined the history of the Association. He said that the movement commenced with informal meetings in the autumn of 1936 between certain members of the staff of the Royal Botanic Gardens, Kew, and the John Innes Horticultural Institution at Merton. These led to the formation, on May 3, 1937, of a joint zoological and botanical "Committee on Systematics in Relation to General Biology". This committee eventually changed its title to the present form, and a council and seven committees were elected. The council at present consists of the following biologists: J. S. Huxley (*chairman* of the Association), H. W. Parker (*zoological secretary*), J. S. L. Gilmour (*botanical secretary*), W. T. Calman, G. S. Carter, M. B. Crane, C.D. Darlington, C. Diver, E. B. Ford, R. Ruggles Gates, H. Godwin, J. W. Gregor, M. A. C. Hinton, J. R. Norman, J. Ramsbottom, O. W. Richards, N. D. Riley, E. J. Salisbury, Miss B. Schafer, T. A. Sprague, W. B. Turrill, B. P. Uvarov, E. B. Worthington, Sir W. Wright-Smith.

Dr. Huxley then explained the aims of the Association, which may be summarized under the following heads:

(1) To examine the theoretical and historical bases and the practical aims of taxonomy, and especially the relation of phylogeny to cytogenetic and taxonomic data.

(2) To examine the criteria employed in defining species and other systematic categories in different groups and the possibility of obtaining greater uniformity in their usage.

(3) To consider how far in the light of cytogenetic, ecological, physiological, embryological, and palæontological data, existing classification might require to be modified and new subsidiary terminology to be introduced. Further, to investigate the relation of any such subsidiary terminology to the International Rules of Nomenclature.

(4) To investigate the data and material already available, either taxonomic or bearing on taxonomy, with the view of correlating them with general biological principles and of establishing generalizations in comparative systematics.

(5) To press for the appointment of additional taxonomists and other biologists to the staffs of museums and other appropriate institutions.

(6) To arrange for research into the relative importance of the various factors, internal and external, operative in different groups in producing speciation and other evolutionary processes.

(7) To co-operate in the production or improvement of handbooks on British animals and plants and in the eventual publication of a British Fauna and Flora on uniform biological lines.

(8) To suggest useful lines of biological work to natural history societies and to amateurs and to assist in its co-ordination.

(9) To investigate the best methods of teaching systematics and field work in universities and schools.

(10) To stimulate discussion and to promote co-operation between workers in different branches of biology on problems of taxonomic interest.

The committees so far formed, together with the particular items of the aims of the Association with which they are concerned, are as follows:

(1) Taxonomic principles (items 1–3). Convener: Mr. J. S. L. Gilmour, Royal Botanic Gardens, Kew.

(2) Comparative systematics (item 4). Convener: Mr. J. R. Norman, British Museum (Natural History), Cromwell Road, S.W.7.

(3) Research (item 6). Convener: Dr. W. B. Turrill, Royal Botanic Gardens, Kew.

(4) Handbooks (item 7). Conveners: Captain C. Diver, 40 Pembroke Square, W.8; Mr. M. B. Crane, John Innes Horticultural Institution, Merton, S.W.19.

(5) Natural History Societies (item 8). Convener: Mr. H. W. Parker, British Museum (Natural History), Cromwell Road, S.W.7.

(6) Education (item 9). Convener: Miss B. Schafer, John Innes Horticultural Institution, Merton, S.W.19.

(7) Publications (other than handbooks). Convener: Dr. C. D. Darlington, John Innes Horticultural Institution, Merton, S.W.19.

At the close of the meeting, fifty-three biologists, in addition to the existing council and committees, gave in their names as members. Any other biologists wishing to join the Association should send their names and addresses to one of the secretaries, stating in which particular committee they are interested. For the present there is no subscription or formal method of election.

Annual Conference of the Museums Association

THE forty-eighth annual conference of the Museums Association was held in Newcastle-upon-Tyne in the week commencing July 5. The chief impression which one gained from the Conference was that museum officials are considering their problems in a new and more critical manner.

The keynote was set by Alderman Charles Squire in his presidential address. As chairman of the Leicester Museums Committee for the past twenty-seven years, he could speak with authority, and did not hesitate to criticize the general failure of municipal councils to make adequate provision for their museums. Museums and art galleries have a high place in the educational and social scheme, and are not yet getting the support which they deserve. Alderman Squire also referred to the valuable work that could be done by museums in assisting to preserve local records and the amenities of the countryside.

Another critical paper was one by Dr. W. E. Swinton (British Museum, Natural History), on "Natural History Museums and the Community". Too many small natural history museums might have as their motto "How best to kill a love of Nature", and Dr. Swinton strongly advocated the elimination of useless material and better display of the collections, so that these might inspire the visitor with a greater interest in plants, animals and rocks in their natural settings. The paper dealt with many other points of practical importance, especially the need for having as curator one who was not only a scientific worker, but also a man of action.

In the same general field there was also a valuable discussion on "Simplifying Habitat Groups", to which Mr. R. K. Perry (Liverpool), Mr. T. Russell Goddard (Newcastle), Mr. W. E. Mayes (Leicester), and Mr. R. Wagstaffe (Stockport) contributed. It was pointed out that in a zoological exhibit it is most valuable to have an indication of the natural habitat of the birds or animals displayed, but that the elaborate group, to be found in the larger American museums, is far too expensive for the smaller English institutions. The proposals made were in the direction of suggesting habitat by branches of trees, by plants, or by other background material, and by the careful arrangement of the specimens in natural attitudes.

On the archæological side, current museum methods were again criticized, the speaker being Mr. Ian Richmond, of Armstrong College. Mr. Richmond answered the question: "What does an archæologist expect of a museum?" He suggested that the museum should contain a full series of local maps, especially those showing human distribution at different epochs; that one exhibit at least should display all the objects and clues that had been obtained from a single excavation; and that, wherever possible, comparative series of exhibits should be set up. He also appealed for a simple classified system of storage of all material not on exhibition.

Within the scientific field there were some important papers of a descriptive nature. Thus, Col. E. E. B. Mackintosh, director of the Science Museum, described the special exhibitions which have been developed at that Museum since 1911. It is interesting to learn that these very successful displays, which in recent years have covered such subjects as refrigeration, rubber, electro-deposition, noise and smoke abatement, electric illumination and television, take from six to twelve months to prepare, and that the cost of the exhibitions has varied from less than £50 to more than £3,000 (the latter cost being borne by the industry concerned).

In his account of the Hancock Museum, Mr. T. Russell Goddard explained that this institution is financed entirely by the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne. It was characteristic of the scientific life of the past century that so much public service had been performed by voluntary effort; but at the present time the finances of the Society are scarcely adequate to maintain the Museum in an effective manner.

Lastly, a valuable account was given by Dr. Kathleen B. Blackburn (Armstrong College) on modern methods of pollen analysis in relation to archæological finds from peat. Mr. H. A. Hyde (National Museum of Wales, Cardiff) also dealt with this subject, and stressed its importance to the museum curator.

On the art side, Dr. John Rothenstein, director of the City Art Galleries, Sheffield, described the work which is being done in his Galleries to give schoolchildren a greater perception and understanding of contemporary art (especially in the form of household objects), while Mr. Richard Bach, of the Metropolitan Museum of Art, discussed the vigorous way in which art collections are brought to the people in New York by the Museum's "Neighbourhood Circulating Exhibitions".

In general discussions the problem of bad museums was considered more than once, and Mr. S. F. Markham (Hon. Empire Secretary, The Museums Association), after carefully defining such museums, advocated that steps should be taken to close them. Dr. C. Hay Murray, in a paper on "Museums as Department Stores", suggested that the curator should regard himself as a salesman, and study the methods of the shopkeeper. No less important, but of a more domestic nature, were papers by Mr. Laurence Vail Coleman, director of the American Association of Museums, on "The Philosophy of a Museums Association", and by Mr. S. D. Cleveland (Manchester) on "The Future of the Museums Association". Judging from the keen interest which the Conference aroused, that future will be an active and successful one.

The next Conference of the Association (of which the headquarters are at Chaucer House, London, W.C.1) will be held at Belfast in the first week of July 1938.

Flight in the Stratosphere

ALL countries which are interested in aviation have been considering the possibility of extending their activities to aircraft in the stratosphere. The greatest advantage in flying very high is that much higher speeds can be obtained for the same expenditure of power as the density of air is so much lower in the stratosphere than at ground-level. The Schneider trophy was won, for example, at a speed of 430 m.p.h. with an engine which gave 2,200 h.p. In the stratosphere, a speed of about 800 m.p.h. could be obtained for the same power. To drive the Schneider trophy winner at the latter speed near the ground would require an engine of 30,000 h.p. If stratosphere flight were possible at 600 m.p.h., then New York would be only five hours from London; so that by local time a passenger from London would arrive at New York before he started.

In vol. 7 of the Cambridge University Engineers' Association Year book recently published, Captain J. L. Pritchard points out some of the difficulties involved in flying in the stratosphere, and concludes that these will probably prevent stratosphere flight becoming a regular service, at least in the present generation. In fact, the increasing engine temperatures due to the difficulty of getting greater cooling may make regular flights in the stratosphere impossible until a new source of power is discovered.

The output of the internal combustion engine can only be maintained if the weight of oxygen it takes in per minute is maintained constant. At an altitude of 60,000 feet, the density of air is only about a tenth of what it is at ground-level. To maintain its output the engine would have to run ten times faster than at ground-level or take in ten times the volume of air.

The former alternative is impracticable so the weight of the air would have to be kept constant by supercharging. During this process, the pressure of the air is raised to about that at ground-level and the temperature by about 300° F. As most of the heat given in the air supplied has to be dissipated, extra cooling is necessary. Despite its low temperature, the low pressure of the atmosphere at this height is a disadvantage. Supercharging requires greater weight of equipment; in fact, the higher the aeroplane the greater its requisite weight.

In 1931, Prof. Picard discovered another fact which increases the difficulties of arranging for cooling. He found that at a height of ten miles, the temperature outside his gondola was −67° F., whilst inside the temperature was 140° F. This was due to the radiant heat absorbed by the gondola. As a method of getting over these difficulties the rocket principle has been suggested. This doubtless would work better at low temperatures than at the ones at which it has been tried. It has to be remembered also that the velocity of sound in the stratosphere is about 700 m.p.h., a speed which enthusiasts think aircraft might attain. Some engineers think that the aeroplane will have a critical speed at this speed, but it is not known how it would get through this critical speed. For this speed, the aeroplane would probably require small wings and the landing speed might have to be about 130 m.p.h.

As an offset to these disadvantages, there would be a great saving of fuel for the journey and the time would be much shorter. In the event also of an emergency landing, there would be a much greater choice of landing grounds, as it would be possible to travel 140 miles with the engine cut off by gliding from a high altitude.

University Events

BELFAST.—In connexion with the annual meeting of the British Medical Association recently held in Belfast, the following honorary degrees have been conferred: *doctor of laws:* Dr. G. C. Anderson, medical secretary of the British Medical Association; Sir E. Farquhar Buzzard, professor of medicine in the University of Oxford, physician to His Majesty the King, and president of the British Medical Association; Dr. H. Morley Fletcher, consulting physician at St. Bartholomew's Hospital and former president of the Association of Physicians; Prof. E. W. H. Groves, emeritus professor of surgery of the University of Bristol: *doctor of science:* Prof. S. P. Bedson, professor of bacteriology in the University of London; Dr. A. Felix, of the Lister Institute, known for his researches on typhus and enteric fevers.

CAMBRIDGE.—The Frank Smart studentship in botany will be vacant on October 1, 1937. Any graduate of the University is eligible for the studentship, which is valued at £210 a year. Further information can be obtained from Prof. F. T. Brooks, at the Botany School.

The Benn W. Levy research studentship in biochemistry will become vacant on October 1. Applications for its tenure should be addressed to Sir F. Gowland Hopkins at the School of Biochemistry before July 24.

LEEDS.—The Clive Behrens lectureship has been instituted by means of an endowment of £1,000 given by the Hon. Mrs. Behrens. The lecturer will be appointed biennially to give a series of four, five or six lectures on a subject germane, and of importance, to the practice of agriculture.

LONDON.—Mr. A. A. Miles has been appointed, as from October 1, to the University chair of bacteriology tenable at the University College Hospital Medical School. Since 1934 he has been University reader in bacteriology at the British Postgraduate Medical School.

Prof. J. H. Dible has been appointed, as from October 1, to the University chair of pathology tenable at the British Postgraduate Medical School. Since 1929 he has held the George Holt chair of pathology in the University of Liverpool.

OXFORD.—E. H. Leach, Oriel College, has been appointed to the new lectureship in physiology on the foundation of William Hulme at Brasenose College.

M. S. Wills, University College, has been awarded the Scott scholarship in physics for two years from October 1.

F. G. W. Knowles, Oriel College, has been elected to the Naples biological scholarship for the year 1937–8.

F. Fulton, Pembroke College, has been awarded the Radcliffe scholarship in pharmacology.

A special number of the *University Gazette* has been issued containing notices of the scholarships and exhibitions announced for the year 1937–8 by the men's colleges. In all, there are about 210 scholarships and 105 exhibitions open for competition. Of these, 37 and 16 are to be awarded for natural science, 13 and 6 for mathematics, 6 and 2 for either natural science or mathematics, and 8 and 5 for any of five subjects of which natural science and mathematics are two.

Science News a Century Ago

A Fatal Parachute Descent

IN Airy's "Autobiography" in the notes on the events of 1837 is one stating, "On July 24th I saw the descent of the parachute by which Mr. Cocking was killed. I attended the coroner's inquest and gave evidence a few days later". Robert Cocking was a landscape painter, who in his earlier days had been a member of the City Philosophical Society with which Faraday was connected. In August 1814, he had lectured to the Society on aeronautics and had received a medal from the Society of Arts. In 1837 he made a curious form of parachute like an inverted truncated cone, 34 ft. in diameter at the top, which was formed of a circular metal tube 2 in. in diameter. A wooden hoop 3–4 ft. in diameter formed the lower edge, and between the hoop and tube was stretched strong linen. It weighed about 150 lb. Being most anxious to try it, he prevailed upon Green, an aeronaut, to ascend in a balloon from the Vauxhall Gardens on the evening of July 24, with Cocking and his parachute suspended beneath the balloon. Having travelled as far as Lee, Cocking released himself, the parachute collapsed and he was killed.

The inquest was held at the Tiger's Head, Lee, and attracted a great deal of notice. Airy had watched the balloon through a telescope, and he and other scientific men gave evidence at the inquest. Green, in his evidence, said that he had an unconquerable objection to parachutes which he considered quite useless and not likely to lead to any good end. In the course of the inquest, Faraday's name was mentioned as having spoken with Cocking at the Gardens before the ascent, and on July 31, Faraday wrote a letter to *The Times* in which he referred to the lecture of Cocking, and his recollection of the inventor's "companionship, abilities and kindliness". The verdict at the inquest was that, "We find that the deceased Robert Cocking, came to his death casually and by misfortune, in consequence of severe injuries received by a fall out of a parachute of his own invention and contrivance, which had been appended to a balloon; and we further find that the parachute did move to his death, and therefore that such parachute ought to become a deodand, and forfeited to the Queen". Cocking, who was sixty-one years of age, was buried in a grave next to that of Halley and Pond at Lee.

Telegraphic Communication on Railways

WHEN Wheatstone and Cooke patented their electric telegraph, Robert Stephenson and the directors of the London and Birmingham Railway sanctioned the laying of wires between the Euston Square and Camden Town stations. Towards the end of July 1837, the telegraph was ready and Dr. Andrew Wynter in his "Curiosities of Civilisation" said: "Late in the evening of the 25th of that month, in a dingy little room near the booking-office at Euston Square, by the light of a flaring dip-candle, which only illuminated the surrounding darkness, sat the inventor, with a beating pulse, and a heart full of hope. In an equally small room at the Camden Town station, where the wires terminated, sat Mr. Cooke, his co-patentee, and among others, two witnesses well known to fame—Mr. Charles Fox and Mr. Stephenson. . . . Mr. Cooke in his turn touched the keys and returned the answer. 'Never did I feel such a tumultuous sensation before,' said the Professor, 'as when all alone in the still room I heard the needles click; and as I spelled the words, I felt all the magnitude of the invention, now proved to be practical beyond cavil or dispute.' The telegraph thenceforward, as far as its mechanism was concerned, went on without a check, and the modifications of the instrument, which is still in use, have been made for the purpose of rendering it more economical in its construction and working, two wires at present being employed, and in some cases only one."

Artificial Digestion

THE *British and Foreign Medical Review* of July 1837 contains the following information: "Dr. T. J. Todd of Brighton with the assistance of Mr. Schweitzer of the German Spa, Brighton, has been performing experiments with the artificial digestive fluid, in imitation of those of Schwann in Berlin and has arrived at some new and interesting results not attained by Dr. Schwann. The digestive fluids with which Dr. Todd operated were prepared from the stomachs of the ox, the horse, the dog and the cat. Some, also, prepared from the upper portion of the small intestines, was found not less powerful. The presence of the acid is essentially necessary in the preparation; when Mr. Schweitzer endeavoured to procure the digestive fluid with distilled water alone, or when he treated the mucous membrane in the same way with a weak alkaline solution, a rapid putridity stopped all further proceedings. Various animal and vegetable substances were submitted to the action of these digestive fluids, at the ordinary temperature of the atmosphere, and the contact result in all the instances had been that these substances have been resolved into their elementary organic globules."

"There has been no exception to this, so far as the experiments have extended, and these include among vegetable substances the artificial digestion of boiled cauliflower, of bread, and of vermicelli, not dressed; and among animal substances, the white of egg boiled, the coagulation of blood, butter, fat, the muscular fibre of mutton and of fish boiled and raw, filaments of the sciatic nerves raw, and scrapings of bone. The products of these artificial digestions especially of the vegetable substances compared with chyme taken from a dog which had been feeding upon ground oats, were very much alike, except that the watery part had been removed from the chyme."

Cure for Drunkenness

THE issue of the *Indian Journal of Medical and Physical Science* of July 1837 contains the following information: "A native of Norway, aged 40, who had from his youth been accustomed to dram drinking, was attacked with delirium tremens. His medical attendant to cure him of his dangerous propensity, prescribed the daily dose of a mixture of two drachms of sulphuric acid and twenty-four ounces of whisky. The result was remarkable. In three months' time he got such a dislike to all kinds of spirituous liquors that he could not bear to swallow a drop of anything stronger than beer. The dose of the above mixture taken, was four wine-glasses daily, and the cure had been of a year's standing at the time of the communication of the case."

Societies and Academies

Dublin

Royal Irish Academy, May 10.

W. J. McCallien: Structure of the Rathmullen District, Co. Donegal. An account is given of the Crana quartzite in the district between Rathmullen and Milford. It can be split into three divisions. The structure of the quartzite group is described, and emphasis is laid on the value of the epidiorite sills in the interpretation of the structure. The base of the quartzite is believed to be a slide, which is folded and overfolded. The Killygarvan limestone, which is younger than the Crana quartzite, is correlated with the Culdaff limestone.

Cape Town

Royal Society of South Africa, April 21.

Archæology of the Oakhurst Shelter, George. (1) A. J. H. Goodwin: Course of the excavation. A description of general methods of excavation, stratigraphy, and cultural remains as observed on six visits to the Oakhurst Shelter. (2) Disposition of skeletal material. An account of the graves, their cultural age and associations, positions of burial and grave furniture. (3) M. R. Drennan: The cave-dwellers. An anthropometrical and descriptive account of the adult population of the shelter. (4) Children of the cave-dwellers. An anthropometrical account of the child population of the shelter, stressing growth and development in relation to the adult group. (5) J. F. Schofield: The pottery. An account of the pottery found in the superficial deposits at Oakhurst shelter.

P. W. Laidler: An unusual grooved stone.

J. F. Schofield: Pottery from the Umgazana and Zigzag caves.

Cracow

Polish Academy of Science and Letters, April 5.

Th. Banachiewicz: The inverse of a Cracovian, and a general solution of a system of linear equations.

W. Jacyna: The differences in the indications of gas thermometers. A helium thermometer at constant pressure gives higher readings than a helium thermometer with the gas at constant volume if the temperature is higher than − 100° C.

F. Gorski: The polarimetric titration of the oxyacids. The author adds an excess of ammonium molybdate, to increase the rotatory power, and titrates with a standard solution of the optical isomer of opposite sign. Errors due to various secondary factors are thus eliminated.

Mme. H. Krzemieniewska and **S. Krzemieniewski**: (1) The Myxobacteria—cellulose-degrading agents. Description of Myxobacteria, especially the family Sorangiaceæ, capable of living on cellulose in the presence of free oxygen. These bacteria can be grown on a synthetic medium containing cellulose and nitrates. (2) The degradation of cellulose by the Myxobacteria.

J. Badian: The cytology of yeasts.

W. Niesiolowski and **R. Wojtusiak**: The geographical extension of forms of the species *Erebia manto*, especially in the eastern Carpathians.

J. Zaowilichowski: Experimental researches on the behaviour of acquired characters in the descendants of *Lymantria dispar*.

B. Hryniewiecki: Count Michel-Jérôme Leszczyc-Suminski, and his study of the development of ferns.

Moscow

Academy of Sciences, (*C.R.*, 14, No. 8; 1937.)

V. S. IGNATOVSKIJ: The Laplacean transformation (5).

P. KOROVKIN: A generalization of Taylor's series.

V. SOKOLOVSKIJ: Concerning a problem of the theory of shells.

N. STRELECKIJ: The factor of safety as an indicator of strength equality of structures.

E. P. OSTROVSKIJ: Generation of powerful sound vibrations by magnetostriction.

K. CH. KEKČEEV: Action of non-adequate stimuli on receptors.

A. E. FAVORSKIJ and M. D. BONE: Methods of determination of the constitution of carbohydrates of the series C_nH_{2n-2}.

P. SCHORIGIN and S. A. SKOBLINSKAJA: The decomposition of ethers (and esters) of cellulose by a solution of metallic sodium in liquid ammonia.

F. M. ŠEMIAKIN and A. I. LAZAREVA: (1) A study of periodic precipitation in aqueous media in capillaries, in the formation of barium carbonate, copper chromate and silver sulphate. (2) Comparative study of periodical precipitations in aqueous media by the Morse and the Ostwald methods.

L. G. DOBRUNOV: Characteristics of the growth and mineral nutrition of hemp with simultaneously maturing male and female plants.

N. V. MOROSOVA-VODJANITSKAJA: Some data on the vegative productivity of the Black Sea.

Rome

National Academy of the Lincei (*Atti*, 24, 323–392; 1936).

E. BOMPIANI: Projective invariants in the theory of surfaces (1). Rapid reconstruction of the theory of projective applicabilities.

L. TONELLI: Problem of Plateau (1).

N. ABRAMESCU: Study of a surface in the region of one of its points, and a new interpretation of the cubic given by the tangents of Darboux and Segre.

E. CASTELNUOVO: A class of rational surfaces which admit ∞^3 transformations projective in themselves.

A. ERDÉLYI: The generalization of a formula of Tricomi.

L. ROTH: Semi-rational varieties in three dimensions.

L. CESARI and F. CONFORTO: The equation of the three moments for a continuous bent beam stressed axially, with a bending rigidity which is variable linearly along each span (2).

L. LABOCCETTA: A more general form of Kepler's third law.

G. ARRIGHI: Isocarene oscillations about the configurations of general equilibrium.

R. MANZONI ANSIDEI: Raman spectrum of aromatic hydrocarbons with condensed nuclei (1). Anthracene and phenanthrene, and their molecular symmetry.

G. B. BONINO: Molecular symmetry of thiophene (2).

G. NATTA and R. RIGAMONTI: Electron diffraction examination of some vinyl polymers.

E. TRIA: Relation between temperature and activity of the glycogenolytic ferment in the liver of poikilotherm animals.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the day mentioned:

PROFESSOR OF CIVIL ENGINEERING, IRRIGATION AND HYDRAULICS in the Thomason Civil Engineering College, Roorkee, United Provinces, India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (July 31).

HEAD OF THE DEPARTMENT OF ENGINEERING, ARCHITECTURE AND BUILDING of the Bradford Technical College—The Principal (July 31).

ASSISTANT ENGINEER in the Mechanical and Vehicle Engineering Section at the Headquarters of the Ministry of Transport—The Establishment Officer (July 31).

ASSISTANT CURATOR in the Rock Garden and Herbaceous Department of the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (August 3).

PERMANENT ASSISTANT (metallurgy) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch) (August 7).

PROFESSOR OF FORESTRY in the University of Aberdeen—The Secretary (November 1).

ASSISTANT LECTURER IN CIVIL ENGINEERING in the Imperial College of Science and Technology (City and Guilds College)—The Secretary.

TEACHER OF ENGINEERING in the Oldham Municipal Technical College—The Director of Education, Education Offices, Oldham.

LECTURER IN MATHEMATICS and LECTURER IN CHEMISTRY in the Kingston Technical College—The Principal.

LECTURER IN ENGINEERING in the Brighton Technical College—The Education Officer, Education Offices, 54 Old Steine, Brighton, 1.

ABSTRACTOR of scientific and technical literature at the Shirley Institute, Didsbury, Manchester—The Director of Research.

Official Publications Received

Great Britain and Ireland

P E P (Political and Economic Planning). Report on the British Social Services: a Survey of the existing Public Social Services in Great Britain with Proposals for Future Development. Pp. 206. (London: P E P.) Paper boards, 7*s*. 6*d*.; cloth, 10*s*. 6*d*. [186

London School of Hygiene and Tropical Medicine. Report of a Meeting of the Ross Institute Industrial Advisory Committee held in the Council Chamber of the Rubber Growers' Association on Friday, 28th May 1937. Pp. 24. (London: London School of Hygiene and Tropical Medicine). [306

The Story of the General Register Office and its Origins from 1538 to 1937. Compiled by the Registrar General and illustrated by certain Exhibits shown at the General Register Office, Somerset House, Strand, W.C.2, in commemoration of the Centenary 1837–1937 of the General Register Office and Registration Service in England and Wales. Pp. 30+6 plates. (London: H.M. Stationery Office.) 6*d*. net. [306

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 1, No. 5: The Early Stages in the Development of the Ferret; the Formation of the Mesoblast and Notochord. By Dr. William J. Hamilton. Pp. 165–193+7 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 6*s*. 3*d*. [306

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1936. Pp. 35. (London: H.M. Stationery Office.) 9*d*. net. [17

Scottish Education Department. Report on the Royal Scottish Museum, Edinburgh, for the Year 1936. Pp. 19. (Edinburgh and London: H.M. Stationery Office.) 3*d*. net. [17

Other Countries

Imperial College of Tropical Agriculture. The Principal's Report for the Year 1935–36 and the Accounts for the Year ended August 31, 1936. Pp. 36. (Trinidad and London: Imperial College of Tropical Agriculture.) [236

Rapports sur la photoluminescence présentés à la Réunion Internationale de Photoluminescence, Varsovie, 20–25 Mai 1936. Publiés par la Société Polonaise de Physique sous la rédaction de Prof. Dr. S. Pieńkowski et Dr. W. Kapuściński. (Vol. 5 des Acta Physica Polonica). Pp. ix+431. (Wilno: Acta Physica Polonica.) [256

Report of the Committee on the Measurement of Geologic Time: presented at the Annual Meeting of the Division of Geology and Geography, National Research Council, May 1, 1937. Pp. ii+77. (Washington, D.C.: National Research Council.) [306

Ringkøbing Fjords Naturhistorie i Brakvands-perioden 1915–1931. Udgivet af A. C. Johansen och H. Blegvad, under redaktion af R. Spärck. (Udgivet paa Carlsbergfondets Bekostning.) Pp. vi+252. (København: Andr. Fred. Høst and Søn.) [306

National Geological Survey of China. Palaeontologia Sinica, Series C, Vol. 7, Fascicle 5: On the Mammalian Remains from Locality 3 at Choukoutien. By W. C. Pei. Pp. 120+6 plates. (Peiping: The French Bookstore.) [17

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 151: Experimental Research on the Effectiveness of Ailerons and Elevators. By Taitiro Ogawa and Kaita Itô. Pp. 349–420. (Tôkyô: Kôgyô Tosho Kabusiki Kaisha.) 1.00 yen. [17

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No. 3535 SATURDAY, JULY 31, 1937 Vol. 140

Freedom of Science and Learning

SO much has been said recently upon the subjects of academic freedom and intellectual liberty that there is a tendency for the terms to become catchwords, as in the much-used phrase "Poverty in the midst of plenty". If this were the main result of the reiteration of the principle that scientific inquiry can only develop to its full extent in an atmosphere of political freedom, it might reasonably be suggested that there has been too much talk about liberty but too little done to secure it. Fifty years ago, as Prof. Hogben reminded us in his Conway Memorial Lecture—"The Retreat from Reason"—T. H. Huxley, in an address on technical education, used the pregnant words "The great end of life is not knowledge but action"; and this principle may be applied very appropriately to the reaction that has resulted from a knowledge of conditions deliberately created to restrict scientific work to particular classes, and thus to destroy the international character of the pursuit of scientific truth.

The group of British scholars and scientific workers who, under the leadership of Lord Rutherford, formed the Academic Assistance Council in 1933 wished to defend the principles of university freedom by actions rather than words. As the Council's report*, which has recently been published, says, the Council has relied on the propaganda of practical achievement, not of protest or agitation. The achievement disclosed by the report is remarkable. Of the approximately 800 refugee University teachers from Germany, 465 are permanently re-established and 320 have been provided with temporary positions enabling them to continue their scientific work. This work has been accomplished during a period of economic depression, which has weakened the absorptive capacities of the universities and increased national protectionist activities in the learned professions of all countries. The report emphasizes that the Council itself is directly responsible for only a part of this achievement; the Council is the institutional expression of a spontaneous activity in the university world to assist the displaced scholars. It is, therefore, the index of a great co-operative achievement by the free universities, the success of which, in contrast to the relatively unsatisfactory progress made towards a solution of the refugee problem in general, proves that it depends chiefly not on motives of compassion but on convictions that the principle of university freedom is involved, and is implicitly defended by assistance for the refugee scholars.

The report is a demonstration of how vigorous is the determination to defend liberty. The work in itself has strengthened that liberty. University teachers, co-operating in the work of academic assistance which the Council has kept consistently on a basis of political neutrality, and associating with the exiles who have suffered by the destruction of liberty, must have learned during the past four years to value more highly the practical advantages of their own freedom. Furthermore, the proof that in a crisis men of science can rely upon the moral and effective support of their colleagues in other countries must have increased that security which is a condition of freedom. It cannot be hoped that the leaders of intolerance and irrationalism will be deterred by the knowledge that their victims will be sheltered in the asylum of liberal countries; but we may hope that their opponents will feel slightly more secure in their opposition, and we shall be spared a repetition of what still remains the most tragic feature of the German disaster, the absence of any stubborn resistance by the universities themselves to the restriction of their freedom.

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* Third Report of the Academic Assistance Council (Society for the Protection of Science and Learning, 6 Gordon Square, London, W.C.1). Copies may be obtained gratis on application to the General Secretary of the Society.

The report makes it clear that university teachers in several countries will need all possible moral encouragement in face of the widening menace to the security of learning. Realizing this, the Academic Assistance Council has converted itself into a more permanent organization, the Society for the Protection of Science and Learning. The dismissal of university teachers in Germany on 'racial' grounds has seen two main phases—that after the original legislation of 1933 and that after the Nuremberg legislation in the autumn of 1935. Information in the last few weeks suggests that a third phase is beginning ; for a considerable number of professors have recently been dismissed merely because they have Jewish wives. Parallel with the series of dismissals on 'racial' grounds there has been a continuing process of dismissals on grounds of 'political unreliability'. The law of January 21, 1935, providing for a 'fundamental reconstruction of the universities' has been used for arbitrary dismissals when the other regulations did not provide so convenient a pretext. The report gives details of the displacement of scholars in other countries on grounds of religious or political opinion ; for example, in Italy, Portugal and the U.S.S.R., and of the beginnings of a refugee movement from Spain in consequence of the civil war. The Society considers that its services are even more necessary to-day than when the Academic Assistance Council was founded in May 1933.

It may be asked why Great Britain should take a leading part in this work of salvaging scholarship wrecked by the subjection of universities within the new authoritarian States, and whether the work is worth while. On grounds of principle, there can be little doubt that our tradition of toleration imposes on us a special responsibility, and that it is justifiable in defending principles to protect those who have been victimized by the non-recognition of those principles. Doubts arise, however, not on theoretical grounds but on practical considerations. The Society's report describes fully its methods of work and convincingly answers the possible criticism that the sheltering of the refugees in Great Britain has injured the interests of British university teachers by pointing out that its work has "protected them from the injury that was threatened in the situation in 1933 when an army of wandering scholars invaded the university world, without guidance or directed distribution, and when no new financial resources were available with which the universities could meet the crisis". It is pointed out that, for the future, the efficiency of the work in re-establishing the scholars will make it necessary for almost all to be assisted to re-establishment in over-seas countries without even a period of sojourn here. We must keep a sense of proportion in this matter. There are 228 German *émigré* scholars in Great Britain, and it cannot be seriously claimed that they threaten the professional interests of the 6,000 British university teachers. During the past four years, the Council alone has added a sum of £65,000 to the resources of the universities, which has enabled them to bear the additional strain so unexpectedly imposed.

Hospitality is a two-way process, and it is evident how greatly the universities have profited from their guests. One of the German men of science who had found asylum in the United States was urgently invited by Herr Rust to return to Germany, where his ancestry would be forgiven because his services were required in the rearmament programme. He declined the invitation, expressing the hope that Herr Rust would succeed within ten years in benefiting the German universities as much as he had benefited the American universities within one year. It is rumoured that a certain institution not far from Cambridge has considered the advisability of erecting a tablet in gratitude for the benefactions bestowed on it by the results of the new National Socialist régime. The pages of NATURE itself almost each week show how much of the learning and talent that was threatened with extinction in Germany in 1933 has been preserved through the agency of bodies like this Society.

In the gloomy pages of the history of the German universities in the last four years, this work of the Society for the Protection of Science and Learning stands out in happy relief. The Council asks for continued support for its activities and hopes that many will associate themselves with the work by becoming members of the Society. Few subscriptions to societies can show such good profit as a guinea membership subscription to this Society, which is trying to protect science and learning.

Messianic Radiation

Star-Begotten:
a Biological Fantasia. By H. G. Wells. Pp. vii+199. (London: Chatto and Windus, 1937.) 6*s*. net.

IT is always interesting to see what a scientific fact will look like after Mr. Wells's imagination has been let loose on it. The facts on which this book is based are that particles or photons of high energy provoke mutation, and that such particles and possibly photons are reaching our planet from outside. What if some intelligent extra-terrestrial beings, perhaps on Mars, are treating us as we treat *Drosophila?* If these beings are as benevolent as they are powerful, may we not expect that our mutations will be of a desirable character, and that the mutants will reform the world? So Mr. Wells's characters argue. Two thousand years ago Virgil was writing:

"Iam noua progenies coelo demittitur alto"; and it is widely believed that his prophecy was fulfilled. Wells predicts not a single saviour, but millions of messianic mutations.

It is worth while pointing out why such a theory, even if there were some evidence for it, would be unacceptable. First, as Wells himself remarks, the cosmic radiation is undirected. As a theme for his next story, I offer him the radiation of about 15 metres wave-length which Jansky found to be reaching our planet from the hub of the universe, or rather of our galaxy, in Sagittarius. Secondly, spontaneous mutation has a fairly high temperature coefficient, and therefore cannot well be due to radiation. Muller discovered this fact before he showed that X-rays are more effective than heat in provoking mutation. But radiations are news, and temperature coefficients are not, so the discovery is generally ignored. Finally, cosmic radiation obeys (if one may use such a word) the uncertainty principle, so even a superhuman marksman aiming at particular genes in human nuclei could scarcely expect much success. It is interesting that temperature fluctuations are equally uncontrollable, so that at present we have no method which promises anything better than a random provocation of mutations, most of which are harmful.

Why, we may ask, has our author chosen this particular theme? Many of my younger contemporaries, in Flecker's words,

"Take no more solace from the palm-girt Wells".

I think they are wrong. He still represents an important tradition, he is a great stylist, and the workings of his mind are most instructive. "Star-begotten", like Stapledon's "Last and First Men" and "Odd John", but unlike his recent "Star-Maker", despairs of existing humanity, and demands beings of innate endowments superior to our own to deal with the present crisis of civilization, which it sketches in brilliant phrases. The author is obviously sceptical of the remedies which he and others have propounded. "Haven't all civilised men nowadays the feeling of being dilletantes on a sinking ship?" asks one of his characters. So with unconquered optimism he puts forward a panacea which he knows to be fantastic.

Some of the undercurrents of Wells's thought are indicative. He is strongly anti-communistic, but he cannot help being influenced by communist ideas. Thus he uses the word ideology, and on p. 165 we find a phrase about mad dogs which perhaps owes something to a speech of Vishinsky's at the first trial of Trotskyists in Moscow. Many of his phrases remain apposite if the letter 'x' is substituted for 't' in Martian. Making this substitution, we read "At the onset of a strange way of living we bristle like dogs at the sight of a strange animal. He hated these Marxians as soon as he thought of them. He could not imagine that their interference with our nice world could be anything but devastating". Another character is more tolerant. "And now these new creatures from outside, these creatures called Marxians, are coming on board our drifting system. With their hard clear minds, and their penetrating unrelenting questions stinging our darknesses as the stars sting the sky. Are they going to salvage us? Shall we let them if they can?"

Whether or not the Marxians have correctly diagnosed the cause of our present distresses, it is clear that evolutionary processes, either natural, or directed by terrestrial or celestial eugenists, are most unlikely to end them. The time-scale of evolution is altogether longer than that of history; and we probably have not many years, let alone generations, to save our civilization from collapse. If this book encourages a single reader to think, even for one moment, that any natural or supernatural process will take the place of human effort and human thought, then it is a bad book. But if it is read as a record of conversations between rather worried intellectuals, it is not only an excellent piece of writing, but also a valuable historical document. J. B. S. H.

The Dilemma of Contemporary Linguistics

Infant Speech: a Study of the Beginnings of Language

By M. M. Lewis. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xii + 335. (London: Kegan Paul and Co., Ltd., 1936.) 12*s*. 6*d*. net.

MR. LEWIS introduces his excellent study of infant speech somewhat dramatically by reminding us how, exactly half a century ago, Max Müller's saying "No thoughts without words" left linguistic studies somewhat in the air. To some, the aphorism went too far; to others not far enough. For the psychologist it was going too far, for obviously symbolic thought without words does occur. Linguistically it did not go far enough, for words mean more than ideas, and in their most important function they are as much a form of human action as any type of bodily behaviour.

To-day, linguists are faced by a similar dilemma. Once we recognize with Mr. Lewis that "language is a form of activity, a mode of human behaviour, perhaps the most important" (p. 5), the question arises: Can we treat language as an independent subject of study? Is there a legitimate science of words alone, of phonetics, grammar and lexicography? Or must all study of speaking lead to sociological investigation, to the treatment of linguistics as a branch of the general science of culture? If the earliest and most fundamental function of speech is pragmatic—to direct, to control and to correlate human activities—then obviously no study of speech except within the "context of situation" is legitimate. The distinction between *language* and *speech*, still supported by such writers as Bühler and Gardiner, but dating back to De Saussure and Wegener, will have to be dropped. Language cannot remain an independent and self-contained subject of study, once we recognize that it is only the general norm of human speech activities. Finally, we shall have to decide whether, with some recent German psychologists, we have to assign three separate functions to speech: the expressive, the evocative, and the representative; or whether we must be satisfied with the admission that speech has only one main function, that of pragmatic control, of co-ordinating human action; while all the other manifold uses and aspects of language are derivative.

The dilemma of contemporary linguistics has important implications. It really means the decision as to whether the science of language will become primarily an empirical study, carried out on living human beings within the context of their practical activities, or whether it will remain largely confined to deductive arguments, consisting of speculation based on written or printed evidence alone. The first view would insist on drawing the material of linguistics from the observation of infant speech, from the study of pathological phenomena in aphasia, from fieldwork on the actual use of language by the various strata of civilized society, and among so-called primitive peoples.

The grammarian and the lexicologist may have in future to abandon their comfortable, two-dimensional world of parchment and paper, and either go into the field, or else rely on material documented not only by words, but also by those aspects of human life, activity, and social organization by which the use of words is determined. The present reviewer, like most modern anthropologists, would plead for the empirical approach to linguistics, placing living speech in its actual context of situation as the main object of linguistic study.

Mr. Lewis is not too dogmatic in the excellent theoretical introduction to his book. He gives there an impartial summary of most modern theoretical work. He himself, however, takes the empirical view that "the main function of language in human life as the mediator between man and man" must be taken as the guiding principle in any linguistic inquiry.

A cavilling critic might note some omissions in his choice of authorities. The absence of any reference to the work of Philipp Wegener, one of the forerunners of the modern movement; or to the American psychologist, G. H. Mead, who perhaps was the first clearly to formulate the principles of pragmatic symbolism; the relatively small space given to the work of Jespersen and Piaget; and the omission of John Dewey's most important contribution, that is, of Chap. v in "Experience and Nature" (1925), might be remedied in a future edition. On one or two formal matters I should like to suggest also an amendment. Thus to state that "speech is an instrument, a tool" is not, as the author supposes, a useful simile, but, like all analogies, an unnecessary handicap. Speech, obviously, is not a tool, but a habit, a standardized type of activity of the human organism. It is, therefore, not to be classed with the material products of man, but rather with the other modes of active human adjustment to the environment and to the mechanisms of culture. Again, Mr. Lewis speaks of "language as an institution". Whatever meaning be given the word 'institution', the label again brings language as a fixed product into the realm of material achievements and leads us away from the study of speech customs within the living context of human activities.

But these are minor criticisms, and they are found only in the theoretical preliminaries of Mr. Lewis's treatise. When he comes to work, and enters his empirical laboratory, all the minor misconceptions vanish. Throughout, he studies the child's speech habits within the circumstances in which they occur. He conducts, in fact, all his observations, in the only admissible manner: he investigates *speech* and not *language*; and investigates it, not as a detached, purely linguistic transfusion of meaning, but as a means of action on adults by the child and conversely the influence of speech and other activities of the grown-up on the child.

This makes the author recognize that to regard the child's spontaneous utterance as merely 'expressive' in its function is erroneous. In fact, through the whole range of the author's observation, the distinction between 'expressive', 'evocative' and 'representative' falls to the ground. Mr. Lewis's results show that the only correct treatment is to study the total situation: the vocal act of the child, which is linked up with the circumstances; and the reactions of the adults which respond to the child's pre-linguistic activity. The meaning of such a vocal act can only be defined as the change produced by the child's utterance in mobilizing its social environment, and making the adults obey its wishes. Obviously, an utterance like this is at the same time expressive, in that it corresponds to the child's feelings of discomfort or anxiety; it is representative, in so far as it is linked up with the situation; and it is evocative in so far as it makes the elders respond to the child's utterance. "Throughout all this the child will tend to use his cries more and more as an aid to the rest of his behaviour, and even as a substitute for it. . . ." In other words, from the very beginning, the human being uses his voice in prearticulate and later on in an articulate sense, in order to achieve, through the assistance given him by others, what he cannot do through his own bodily activity.

The work of Mr. Lewis is in many ways a great advance on all previous experimental studies on child speech and a valuable contribution to the theory of language. In his use of older sources, he is judicious, critical and comprehensive. In the setting of his own observations, he has taken his inspiration from the most scientific, that is, the most empirical point of view in modern linguistics.

B. MALINOWSKI.

Elementary Chemistry and its Presentation

New Practical Chemistry:

Fundamental Principles applied to Modern Life. By Prof. Newton Henry Black and James Bryant Conant. Pp. xi+621. (New York: The Macmillan Co., 1936.) 7*s*. 6*d*.

New Laboratory Experiments in Practical Chemistry

To accompany Black and Conant's "New Practical Chemistry". By Prof. Newton Henry Black. Pp. x+193. (New York: The Macmillan Co., 1936.) 5*s*.

THESE are welcome and important additions to the large number of text-books which deal with the fundamental principles of chemistry and their mode of presentation. Anyone still unconvinced that a knowledge of the fundamental principles of an ever-expanding science and some of their applications may not be a part of a general education might do well to make a detailed study of these books, one of the authors of which is a distinguished organic chemist, well known in Great Britain, and president of Harvard University.

Much difference of opinion exists among those occupied with the teaching of elementary chemistry concerning the method of presentation. Unlike the authors, some prefer to adhere, so far as possible, to a more or less historical method, and to leave any consideration of the developments of the subject during the last twenty-five or thirty years to a later stage of the student's training. This has the disadvantage that the student who does not continue the more detailed study of the science has little knowledge of the structure of the atom, by which the properties of the elements and the structure and properties of chemical compounds are more adequately explained.

The presentation of the fundamental theories and facts of chemistry by the authors is excellent. Perhaps, at times, it is too didactic, and formulæ of compounds are stated before any description of the compounds is given. This might cause difficulties for the student who reads without the guidance of a teacher. But the books are not intended for home reading. Even the title of the larger volume, dealing with the more theoretical side of the subject, indicates that chemistry is a practical science, and the companion volume gives a comprehensive series of experiments to be carried out *pari passu* with the theoretical instruction. These not only include qualitative and quantitative exercises of the usual type prescribed for the beginner, but also experiments on soil testing, colloids, textile fibres, blue prints, dyeing, paints, food components of milk and identification of simple compounds. An elementary knowledge of such subjects might be frowned upon as being too technical to form part of general education; but it does provide possible stimuli on which later interest, whether for profit or leisure, may depend. It is no mean achievement to give such information without in any way sacrificing the accurate presentation of the essential facts and theories of chemistry.

It is rare to find elementary text-books so stimulating as these, and they would be unique if they were entirely free from faults. Some chemists would not agree with the authors' explanation of the apparent dual valency of phosphorus, and perhaps many teachers would hesitate in the first year of a student's training to give so detailed an account of Bohr's theory of spectra. From the teacher's point of view, however, it is important to realize that the authors show it can be introduced without much difficulty.

The authors state that they have" enriched the treatment by exceeding the factual requirements of the College Examination Board". It is to be hoped that this is the case, because the books are so comprehensive in subject-matter. This ranges from the early history of the science to atomic structure, from the "New Periodic Law" to radioactivity and transmutation of the elements, and from coal and oil to dyes, paints and vitamins. All these are apparently to be studied in one year, and presumably the student takes other subjects besides chemistry. Perhaps American students, for whom the books are primarily written, work harder than British students. Even if the user of these books is merely a candidate for a college entrance examination, he is fortunate in having the fundamental theories and facts of chemistry and some of their applications presented to him in so fascinating a manner.

CHARLES S. GIBSON

Operational Symbolism in Mathematical Analysis

The Theory of Linear Operators:
from the Standpoint of Differential Equations of Infinite Order. By Harold T. Davis. (Monograph of the Waterman Institute of Indiana University, Contribution No. 72.) Pp. xiv+628. (Bloomington, Ind.: The Principia Press; London: Williams and Norgate, Ltd., 1936.) 35*s*. net.

THE modern philosophy of physical science leans strongly to the view, so well expressed by a recent writer, that the concept is synonymous with the corresponding set of operations. The idea of mechanical imagery advocated by Lord Kelvin is thus being replaced by the notion of an operational process which accordingly presupposes the existence of a law of transformation. To mathematicians, this aspect has long been the subject of profound study, but not until comparatively recently has the idea permeated the theoretical domain of science.

The formal theory of operators is generally considered to have originated with Leibniz and Lagrange, whilst in Great Britain the subject was mainly stimulated by George Boole, who clarified our fundamental ideas in both logic and mathematics. Then came the generatrix calculus which Laplace made the basic method of his "Théorie analytique des Probabilités". A further stage in the development of operational methods arose from researches in electrical communication, out of which came the once-spurned operational calculus of Oliver Heaviside, a self-taught mathematical man of science. Finally, Volterra and Fredholm laid the foundations of the theory of integral equations and, later, the calculus of forms in infinitely many variables out of which, from the modern study of the quantum mechanics and the properties of electrons, has sprung the matrix calculus.

These main divisions of the theory of operators are all discussed with some detail in Chap. i of the volume under review, which was written, as a result of considerable research, to provide an outline of the theory of linear operators and its manifold applications to general types of linear functional equations. The volume is published as a monograph of the Waterman Institute of Indiana University, and surveys the theory of linear operators from the point of view of the theory of differential equations of infinite order.

The development centres round the generalized differential operator. Several chapters are devoted to the definition and properties of operators, namely, particular operators, operational multiplication and inversion, grades defined by special operators, etc. Some very interesting examples are given in this section illustrating the application of operational processes. These include such important problems as the development of the disturbing function in planetary motion involving Newcomb operators; the propagation of electromagnetic waves in which Silberstein's elegant operational solution is used, and finally the propagation of population by fission, to which the operational method of Rawles is applied. Chapters vi and vii are devoted to differential equations of infinite order with constant coefficients, and linear systems treated by the Heaviside calculus.

Illuminating chapters then follow on the Laplace type of equation of infinite order, in which the coefficients are polynomials of bounded degree; the generalized Euler equation of infinite order; Fuchsian operators of infinite order, and the Volterra and Fredholm integral equations of infinite order, in which a full description of Lalesco's theory is given. The closing chapter is devoted to the theory of spectra and, after giving some important theorems on matrices concerning transformations, identities and Hermitian, the author proceeds to discuss the equivalence of the theories of quadratic forms and integral equations and, finally, some general considerations on the continuous spectra of quadratic forms.

Throughout the text, which is very clearly written, many applications to science have been indicated, and an extensive bibliography is provided at the end for further reading. Those interested in the subject will be grateful to have, within one cover, so complete an account of the new operational symbolism which has become one of the important methods of extending the domain of mathematical analysis.

F. G. W. B.

A Text-book of Aerodynamics

Elements of Practical Aerodynamics
By Prof. Bradley Jones. Pp. v + 398. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 18*s*. 6*d*. net.

As the author claims in the preface, this is a student's text-book of American origin, and as such is an admirable exposition of the subject. It gives worked-out examples in the text and further examples for the student at the end of each division. This is a principle that has always been advocated by educationists, but seldom followed by writers of books on aeronautical subjects up to the present day.

The author states, apparently as a recommendation, that he has avoided the use of the calculus except upon two occasions. It is a little surprising to find fear of this branch of mathematics in any modern scientific book, more especially one expressly written for students, who surely must be beyond the study of such elements of it as would have been necessary in such a book before they even reach the stage of studying aerodynamics.

The first few chapters, dealing with the aerodynamics of the aeroplane, are extremely clear and lucid, but they should have been followed by the chapters on stability, control, etc., so as to read as one continuous argument. One would like to have seen more on skin friction, laminar and turbulent flow, and such matters, treated as lucidly as the rest of the aerodynamics in these chapters.

The chapter on stability infers that lateral stability is less difficult a subject than longitudinal stability, a statement with which few aeroplane designers will agree. The mathematical consideration of it in theoretically undisturbed air may be, but this is only the introduction to the real practical problem with disturbed motion.

The second half of the book is made up of accurate, but quite inadequate, chapters on subjects such as materials, instruments, meteorology, 'avigation' (American for aerial navigation) and aerostatics. These are good, so far as they go, but are very elementary in character, and out of balance with the treatment of the subject-matter of the earlier chapters.

In general, this is a book that should appeal to students in Great Britain, to be taken as additional reading, giving a rather different American outlook on the subject. Now that we have adopted the same units as used in the United States, it will be less confusing to the beginner.

Death from the Skies:

a Study of Gas and Microbial Warfare. By Heinz Liepmann (with the scientific assistance of Dr. H. C. R. Simons.) Translated from the German by Eden and Cedar Paul. Pp. 286. (London: Martin Secker and Warburg, Ltd., 1937.) 6*s.* net.

THE author of this sensational book claims to have received information from certain authoritative sources which it would be inexpedient for him to acknowledge; but there seems to be nothing new in his disclosures, and all the probable war gases which he lists as "pre-eminently suitable" can be found in any of the books that have been published on this subject. He believes that "hundreds of millions" will perish from gas in the war that is to come. "Just a minute or two of a hideous struggle for air, and then death—lucky, perhaps, if it is over so quickly. In former days men condemned to death were at least given time for a prayer. Not these, not these. They groan, they scream, they suffocate, they die."

We hear again of the same old gas bomb which, falling in Piccadilly Circus, would destroy all life between Regent's Park and the Thames; and amongst the "authorities" on whom he depends he even includes an entry in a record of the German Patent Office. He comes to the conclusion "that there is no protection against poison gas. Anyone who says such *protection is possible is a liar.*" *Similarly*, there is no defence against bacteria; and, should war break out within the next few months, Germany will wage bacterial warfare, and we may expect glass flasks filled with cultures and contaminated rats dropped from aircraft by means of small parachutes.

The author is mistaken in saying that the British General Headquarters undertook costly chemical experiments before the outbreak of the Great War in the expectation that poison gas would be used. He is also misinformed in supposing that no known gas mask can protect against blue cross gas; and quite wrong in describing the Chemical Warfare Research Committee as a joint Allied organization, and in stating that (the British) General Thuillier succeeded (the French) General Curmer as head of the French State Commission for Gas Service. His description of the present condition of Germany is quite the most interesting part of the book—"a poverty stricken and dangerous land, a focus of unrest for Europe, in imminent danger of exploding —the explosion being prevented only by a reign of terror unexampled in history". Hitler, he thinks, will inevitably embark on expansionist adventures, and a decisive struggle between Britain and Germany must occur.

C. H. F.

The Journal of the Institute of Metals

Vol. 59. Edited by G. Shaw Scott. Pp. 323+22 plates. (London: Institute of Metals, 1936.) 31*s.* 6*d.*

IN September last year, the Institute of Metals held its autumn meeting in Paris, and this volume includes the sixteen papers presented on that occasion, together with the Autumn Lecture on "The Scientific Organisation of Works" by Prof. Pierre Chevenard, scientific director of the Société de Commentry, *Fourchambault et Decazeville. This lecture is a remarkable and convincing account of the successful application of scientific methods throughout a large industrial* concern.

A considerable proportion of the papers published in this volume deal with the alloys of aluminium; M. Gauthier describes the effect on the conductivity of super-purity aluminium of additions of those elements which may occur as impurities in commercial aluminium; Mr. N. D. Pullen presents an account of a new treatment for the production of reflecting surfaces on aluminium, while Prof. Portevin and Dr. Bastien treat the property of forgeability in a fundamental manner.

A lengthy paper by Atkinson and Raper provides up-to-date metallurgical information on the six metals of the platinum group, while Northcott discusses veining and sub-boundary structures in metals. Other papers deal with the creep of tin and tin alloys, fluxes for use in soldering, and the constitution of the alloys of cadmium and tin and of indium and lead.

Statistical Year Book, 1937, of the International Tin Research and Development Council

Pp. 206. (London: International Tin Research and Development Council, 1937.) 6*s.*

THE *International Tin Research and Development* Council has carried out a useful task in issuing a comprehensive statistical year book, which deals not only with production and trade but also with the varied aspects of consumption. The use of tin in the automobile industry on one hand (8 per cent of the total world consumption) and in the canning industry on the other (50 per cent of the total) are indications of the widespread importance of this key metal. In spite of this, the production is very localized and about 85 per cent of the output comes now under the control scheme. Of the total world output in 1936 of 179,600 long tons, Malaya produced 66,806; the Netherlands East Indies 31,546; Siam 12,678; Bolivia 24,074; Nigeria 9,529 and China 10,664 tons. The greatest consumer, the United States, had a home production (including Alaska) of 87 tons, and the great European users have similarly tiny supplies only.

L. D. S.

The Technology of Aluminium and its Light Alloys

By Prof. Dr. Alfred von Zeerleder. Translated from the second German edition into English by A. J. Field. Pp. x+301. (Amsterdam: Nordemann Publishing Co.; London: Crosby Lockwood and Son, Ltd., 1936.) 21*s.* net.

THE original German edition of this book was published in 1934, and a second edition was found necessary in less than twelve months. From this second edition Mr. Field has prepared the present translation, and has also brought the text rather more up to date. The book gives in condensed form the essentials of the working of aluminium and its alloys, the object being to bring home the merits and possibilities of aluminium to a wide circle of users and potential users. This purpose it fulfils admirably.

Greenland Culture. (2) The Eskimo*

THREE reports issued recently by the Commission for Scientific Research in Greenland deal with the culture of the Eskimo in East Greenland.

(1) *Kangerdlugssuak District.* An expedition of the Scoresby Sound Committee, of which Einar Mikkelsen was in charge and Magnus Degerbøl responsible for the archæological investigation, examined the coast from Cape Dalton to Kangerdlugssuak, an area of great interest, as it is situated between the Angmagssalik Settlement in the south and the former Eskimo area of settlement in north-eastern Greenland from Scoresby Sound northwards. Before 1932, this region had been traversed only by the Amdrup expedition of 1900, which found a number of deserted Eskimo habitations, graves, tent-rings, etc., at the mouth of Kangerdlugssuak, but no remains from Kangerdlugssuak to Scoresby Sound, nor north of Cape Dalton to Dunholm, where, however, Eskimo remains existed. The present expedition confirmed this result, and it was only at Miki's Fjord, a few kilometres east of Kangerdlugssuak, that it was possible to prove former habitation. An inference that Irminger's Fjord was once the site of a habitation has later (1935) been proved to be correct.

Miki's Fjord is well suited to habitation. Here a ridge runs north-south, with terraces sloping to the south. A firm rocky ledge affords room for movement and building, with easy access to the sea. The only drawback is an absence of fresh water. On this terrace were five sets of house ruins, at different levels, the lowest being the largest and best preserved, though there is reason to believe that the smaller were parts only of houses originally larger. All the houses, with one exception of indeterminate shape, were rectangular. The objects found in the houses were essentially of the same culture period, and belong to the Inugsuk culture. The number of skeletal remains found in the house, together with the secondarily formed small houses, suggests that the population did not emigrate, but perished in their homes, possibly from malnutrition due to a lack of vegetable food. Animal food was evidently plentiful.

A woman's grave found on a small headland is one of the largest grave finds in Greenland, and contains several objects not known from other finds. An entirely new element, not previously known in Eskimo culture, is eighty-four beads, small white circular disks of mussel shell, while a needle case containing two needles of walrus ivory is the first example of a bone sewing needle from Greenland. An explanation put forward by Th. Mathiassen of the distinctive character of certain of the cultural objects is that the length of occupation gave rise to independent development.

The character of the remains and deposits shows that the occupation was one of considerable length. Immigration probably took place at the end of the fifteenth, or beginning of the sixteenth, century; and occupation, it is thought, may have lasted until so late as the eighteenth century.

(2) *Frederik VI's Coast.* An expedition in 1931–33, of which Knud Rasmussen was leader, made a study of former Eskimo settlements on this coast between Prince Christian Sound on the south and Ikerssuaq, the boundary of the Angmagssalik district, on the north, with the purpose of determining the number and character of the Eskimo settlements which were known to exist, but of which exact information was lacking. As many settlements as possible were inspected, and a few excavations were made. From all sources, including those already in print, as well as from information received, three hundred and eighty-two settlements were recorded in eleven regions. In 1931 Erik Holtved excavated eleven house sites, producing seventy-two artefacts, and in 1932 Th. Mathiassen excavated twenty-one ruins, producing 526 specimens.

The house types fall into the following categories: (1) small, rounded, and much overgrown and flattened-out houses; (2) small, four-sided, partly flattened-out houses; (3) large, four-sided, partly overgrown houses; (4) houses known to have been inhabited in the nineteenth and twentieth centuries.

The most important site investigated was Ruinnæsset on Skjoldunge Fjord. Here Knud Rasmussen discovered a great house complex. From this site alone 329 specimens were obtained.

In regard to the character and succession of cultures, it would appear that the earliest house ruins on this coast are probably contemporaneous with the earliest houses in Angmagssalik, and belong to the end of the fourteenth, or beginning of the fifteenth, centuries. They are small, round, and dug down into the ground, with poorly built walls, paved floors, sunk passages and often a cooking extension. Sometimes two or three are built together, forming a clover-leaf shaped complex. Their culture shows evidence of some whaling. There are no glass beads. The culture is of the same type as the Angmagssalik, and belongs to the Inugsuk culture.

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* The Scoresby Sound Committee's 2nd East Greenland Expedition in 1932 to King Christian IX's Land—The Former Eskimo Habitation in the Kangerdlugssuak District, East Greenland. By Magnus Degerbøl. (Meddelelser om Grønland, Bind 104, Nr. 10.) Pp. 48+1 plate. 2.50 kr.

6 og 7 Thule-Expedition til Sydøstgrønland 1931–33—The Former Eskimo Settlements on Frederik VI's Coast. By Therkel Mathiassen. (Meddelelser om Grønland, Bind 109, Nr. 2.) Pp. 58. 2.50 kr.

The Eskimo Archæology of Julianehaab District, with a Brief Summary of the Prehistory of the Greenlanders. By Therkel Mathiassen, in collaboration with Erik Holtved. (Meddelelser om Grønland, Bind 118, Nr. 1.) Pp. 141+4 plates. 7.00 kr.

(København: C. A. Reitzels Forlag, 1936.)

The first article appeared in NATURE of July 10, p. 52.

The seventeenth-eighteenth century house, of which sixty small, and seventy-seven large, were seen, is distinctly four-sided. At first small; later, in the eighteenth century, it becomes the large common house, which seems to have been introduced by a migration from the west coast, reaching as far as Angmagssalik. Houses of this type were seen at fifty-one settlements. The culture is particularly well displayed in the finds from Ruinnæsset. It is derived from the contemporary South-west Greenland culture, but with a special south-east coast stamp. This find is given a special character by the many drilled seal jaws.

Fifty-six houses on this coast are known to have been inhabited in the nineteenth century, or later. Records of this period were made on the voyage by W. A. Graah in 1829–30, when 536 Greenlanders lived here in summer. The movement to the west coast had already begun, the last south-easters moving to the southern part of the west coast in 1900. At the present time, it is visited occasionally only for sealing.

(3) *Julianehaab District.* In the course of an expedition sent out by the Commission in 1934 a comprehensive survey was made of the Julianehaab district, the most southerly part of Greenland's west coast, and its most fertile and thickly populated area. It forms a connecting link between East and West Greenland, and was the site of the principal Norse settlement. The main interest of the expedition was the investigation of early Eskimo settlement, of which very little systematic knowledge was previously available.

It is now known that there are two hundred and forty-six places in the district where there have been Eskimo winter settlements. Of these, one hundred and thirty were visited. Excavation was possible on four sites only. Here fifty-six house ruins, four hundred square metres of midden, and twenty-three graves were examined, producing 1,808 specimens and fifty-seven skeletons. The house types are an early group of round or rounded small houses, sometimes two or three built together with a common passage; two types of the seventeenth–eighteenth century, distinctive, rectangular with a high stone wall and a sunken passage at right angles to the house, large; but the later type small; and fourthly, the nineteenth century house, small, rectangular, with high stone and turf walls and a passage in prolongation of the longitudinal axis, often with a bend and not sunken, and with a kitchen or storehouse as an offset in the angle. This last is the type now in use, though it is being displaced by wooden houses.

The conditions for the preservation of cultural objects in the Julianehaab district are adverse in the extreme, owing to the succession of frost and thaw and the percolation of water. As a result of this, most of the ruins contained no bones or wood.

In the houses of the earliest type, most of the objects are of the kind known from other sites in Greenland and belonging to the Inugsuk culture. Among the most interesting and important were the lamps, which by their varying form afford a guide to chronology. Those with wick-ledge or knobs are a characteristic type of the culture. A number of objects of Norse origin probably represent spoil from the houses of the Norse settlement, which were deserted when the settlement decayed soon after the first appearance of the Eskimo in 1379. The earliest Eskimo culture of the District may be dated as lying within the period 1350–1650. Early settlement was invariably, so far as observed, half-way up the fjords, the situation most favourable for ice hunting. The principal quarry, as shown by the bones from the sites, was the seal, but the caribou and the whale were of importance.

The finds of cultural objects from the seventeenth–eighteenth century houses do not differ essentially from finds from other parts of Greenland. Glass beads were found in most of the ruins, but in no great numbers. The principal varieties are the large opalescent, the large facetted—blue, yellow and colourless—a large black, a large rather flat dark blue, and a cylindrical bead, red with white longitudinal stripes. Although the culture as a whole compares with that of West Greenland, it has in its harpoon-heads, arrowheads and lamps an older stamp, as indicative of an out-of-the-way situation. The same old-fashioned types are recognizable at Angmagssalik, the similarity appearing in a relatively large number of objects, such as salmon spear, fish hooks, pendants, etc. The animal bones show that sealing had been the principal occupation; but the inhabitants also hunted whales, caribou, white-whales, bears, foxes and fowl. In certain periods there have been many fish, especially cod. There is also a surprisingly large number of dog bones, but no proof of sledge traction.

The development of the kayak, and the consequent increased utilization of sea locomotion for hunting and fishing, led to a diffusion of settlement, the number of small settlements increasing markedly. In the following period of the nineteenth and twentieth centuries, however, the number of small settlements declined, and large settlements again prevailed, in order that the population might be near the centres of commerce and industry, which grew up with European settlement. The introduction of wooden houses put a further check on the nomadic habits of the people.

The mummy caves at Querrortut were also investigated. Though much disordered by a previous party of archæological investigation, remains of desiccated bodies were found, which may be attributed to interment and not to incarceration and death from starvation. The occurrence of grave goods points to the pagan period, and tentatively a sixteenth century date is assigned.

Summarizing his survey of prehistoric Eskimo culture in Greenland, Dr. Mathiassen reconstructs their ethnic history by attributing to them an origin in arctic Canada, whence they came about a thousand years ago, with whale-bone houses and the Thule culture, to settle in the Cape York District. Thence they passed southward over Melville Bay to northern West Greenland, where they remained for several hundred years, encountering the Norsemen travelling northward, and changing the Thule culture into the Inugsuk culture. In the fourteenth century the growth of population forced them to seek new hunting fields. South Greenland was populated in the course of this century, the Norsemen being overrun. A group of Eskimo wandered around Cape Farewell to the east coast and far to the north along the coast. In the seventeenth century Polar Eskimo migrated north about Greenland and mixed with north-east Greenland's early population. Shortly afterwards, West Greenlanders reached Angmagssalik, while a small remnant of survivors from the first immigration to the east coast at Kangerdingssuaq died out, as also did the inhabitants of north-east Greenland. In West Greenland, however, the population grew rapidly, helped by Danish settlement; while at Cape York there was still a remnant of the old Thule Eskimo, helped by a new immigration from Baffinland.

On the general Eskimo problem, Dr. Mathiassen expresses the opinion that it cannot be solved in Greenland. He is, however, unable to accept K. Birket-Smith's Caribou Eskimo theory, which makes Eskimo culture a link in a circumpolar inland culture, first created in the central parts of arctic Canada. The Thule culture points to Alaska and possibly Siberia.

The Halle Academy, 1652-1937

THE Kaiserlich Deutsche Akademie der Naturforscher at Halle has recently celebrated the two hundred and fiftieth anniversary of the granting of its charter. In 1652, soon after the end of the Thirty Years' War, there was founded by four physicians, in the Reichsstadt of Schweinfurth, a scientific society under the name of *Academia Naturae Curiosorum*. The principal founder and first president, Johann Lorenz Bausch, had studied in Italy and become acquainted with the local academies of that day, and especially with the Lyncæorum Academia, now Accademia Reale dei Lincei; he was also influenced by the writings of Bacon of Verulam. In 1677 the Emperor Leopold I recognized the society as the Academy of the Holy Roman Empire, and ten years later the same prince bestowed upon it considerable privileges and the title of *Sacri Romani Imperii Academia Cæsareo-Leopoldina Naturæ Curiosorum*. Arms were granted, with the motto: "Nunquam otiosus"; the president and the editor of the ephemerides received golden chains of office; they and their successors became counts palatine of the Holy Roman Empire; as such they could legitimize bastards, confirm the liberation of slaves and perform other legal functions. They could, moreover, confer the titles of doctor, licentiate, master and bachelor, in the faculties of medicine, philosophy and laws; they could even appoint poets laureate. The doctorates so conferred were to secure the same privileges as those given by the universities. The publications of the Academy were exempted from censorship and protected as to copyright.

The Academy has survived the Empire from which its privileges were derived; these privileges were never abolished, but their exercise fell into abeyance. So did the curious custom, recognized in the imperial charter of 1687, of giving 'symbolic' names to its members; thus the first president was known as Jason I, his successor as Argonauta I. Meetings also fell into abeyance, and the activities of the Academy became restricted to the publication of a scientific periodical and to the administration of its library and museum. The location of the latter at first changed with that of the president, until the Academy became definitely established at Halle. Its natural history collections have been dispersed, but its library remains rich in valuable periodicals, of which a recently published catalogue enumerates some 3,650 items ("Verzeichnis der periodischen Schriften der Bibliothek der Kaiserlich Leopoldinisch-Carolinisch Deutschen Akademie der Naturforscher, Halle (Saale)", 1937). The most important work of the Leopoldine Academy has been the publication of a journal, *Miscellanea curiosa medico-physica Academiæ naturæ curiosorum sive Ephemerides Germanicæ*, started in 1670 and probably the oldest scientific periodical. In the eighteenth century this valuable journal changed its name to *Acta physico-medica* and then to *Nova acta*; in 1932 a new series, *Nova Acta Leopoldina*, was started.

Various scientific funds have been lost as the result of economic upheaval, but a bequest by Christian Andreas Cothenius, the physician of Frederick the Great, is still operative; in accordance with it, a medal is from time to time awarded for scientific research. A second medal and a research fund was more recently instituted in memory of Auguste Henri Forel, the biologist and sociologist.

It will be seen from the above account that in modern times the Cæsareo-Leopoldina has received no official protection, nor been subject to governmental control. It is one of the oldest of scientific societies; the Royal Society has indeed the older charter, the Lincei Academy the longer history, albeit not so continuous. The present year is the two hundred and fiftieth after the granting of privileges by Leopold I, and this anniversary was celebrated at Halle on May 28–30. The commemoration was attended by representatives of numerous universities, academies and societies, both German and foreign, who were welcomed in the aula of the University by Prof. E. Abderhalden, the president of the Academy, who has done much to stimulate its activities. His opening address, a historical retrospect, was followed by official congratulations from the rector of the University and the mayor of the city. Then came brief speeches on behalf of the Royal Society of London, the Accademia delle Scienze of Bologna, the Accademia dei Lincei of Rome, the Academies of Vienna, Amsterdam, Copenhagen, Tokyo, the American Academy of Arts and Sciences, at Boston, the Kartell of the German Academies (Berlin, Göttingen, Munich, Leipzig, Heidelberg), etc. It was announced that a sum of 44,000 marks had been collected from numerous donors, to be used henceforth as a research fund.

A very noteworthy lecture was then delivered by Prof. Hans Spemann, of Freiburg, on his recent researches concerning the nature of animal development. Finally, the Cothenius medal, referred to above, was awarded to Profs. Dante de Blasi (Rome), Ostertag (Tübingen), Franz Volhard (Frankfurt), G. Barger (Edinburgh), Max le Blanc (Leipzig), Armin Tschermak-Seysenegg (Prague) and Eugen Fischer (Berlin). In the evening there was a banquet with a few speeches. Next day further lectures were given; there was an admirable performance of an operetta in the municipal theatre, and a pleasantly informal reception by the Oberbürgermeister; the third day, a Sunday, was devoted to an excursion in the country.

In connexion with this very successful celebration, there have been printed the above-quoted catalogue of periodicals in the Academy's library, and a well-illustrated *Festgabe* containing three historical essays and Prof. Spemann's lecture.

International Agreement for the Regulation of Whaling

THE International Agreement for the Regulation of Whaling, which was published on June 23, marks an important stage in the development of whaling regulation. It was the work of a conference at which eleven Governments interested in whaling participated. They met on May 24, and sat almost daily until June 8, when the Agreement was signed. The drastic nature of its provisions are eloquent of the practically world-wide conviction that whaling can be saved from collapse only if it is rationally regulated: while a note under the title "Final Act", which is appended to the Agreement, indicates that the possibility is recognized that actual restriction of whaling effort may prove necessary if that end is to be achieved.

In the early stages of modern antarctic whaling, the scale on which destruction of the whale stock was wrought made the need of regulation apparent. The Falkland Islands Government, which controlled practically all antarctic land stations, gradually built up a system of regulations and—a feature not yet attempted for whaling as a whole, restriction of the number of whaling vessels—which, while provisional in character owing to lack of information, may be said to have proved adequate until the late 'twenties, when the building of ships capable of working up the whales on the high seas took the main body of whaling into international waters. The Norwegian Whaling Law of 1929 imposed on Norwegian whaling the provisions of the Falklands regulations except limitation, and added the power to prohibit Norwegian whaling in tropical and subtropical waters.

The Geneva Convention of 1931 followed the lines of the Norwegian law, though without provision for closing areas to whaling. This convention expressed the maximum to which at the time general agreement could be secured. It was recognized that whaling, being mainly outside territorial waters, could be dealt with only by common action, and the inauguration of international treatment was the first object to be attained. The majority of whaling countries adhered to it, and put its provisions into force by legislation which, with the increase of knowledge, tended to go farther and to be more definite than the convention it implemented. Limitation of production was effected by agreements within the industry in several recent seasons: but from various causes these agreements became increasingly difficult to reach, and the International Conference accordingly became necessary.

Space will not permit of any detailed account of the measures taken so far, but it will be useful to summarize the position in the antarctic when the Conference opened, among the countries adhering to the Convention. Only baleen (whalebone) whales were dealt with. Among these Right whales (*Balæna glacialis*), the numbers of which had been reduced almost to disappearance, were protected completely. Protection of other species was partial. It was illegal to kill immature whales, or cow whales with calves, and lengths were laid down below which for the purposes of the regulation Blue (*Balænoptera musculus*) and Fin (*B. physalus*) whales were to be considered immature. The number of whales killed to afford a given quantity of oil was kept as low as possible by requiring the utmost practicable utilization of each carcass. The pay of gunners had not to depend merely on the number of whales shot. Full records had to be kept of the whales killed and the oil produced. Other provisions, such as the partial protection of the Humpback (*Megaptera nodosa*) in the Falkland Islands Dependencies, were to be found in certain cases.

The agreement now reached affords complete protection to the Grey whale, *Rhachianactes glaucus*, as well as to all Right whales. The lengths below which Blue and Fin whales may not be taken is advanced from 60 ft. to 70 ft. and from 50 ft. to 55 ft. respectively. The mean size of these species in the antarctic at first maturity was determined in the "Discovery" Investigations as 74 ft. 2 in. for male and 77 ft. 9 in. for female Blue whales, and 63 ft. 8 in. for male and 65 ft. 7 in. for female Fin whales. The new limit is thus a marked approach towards the actual mean size at maturity. For the first time, minimal size limits were laid down also for Humpback and Sperm whales (*Physeter catodon*); namely, 35 ft. in each case, this length having a similar relation to the size at first maturity of Humpback and male Sperm whales, according to the best available information and protecting female Sperm whales. Those familiar with the sizes of the whales taken in commercial operations will realize the large body of whales these limits will preserve to reproductive size. It may be noted also that the limits will apply to shore stations.

The seasons for whaling are restricted. Antarctic whaling, that is, whaling south of 40° S., will take place only from December 8 until March 7, though there is a short extension for next season only; and no shore station may operate for more than six months in the year.

Lastly, pelagic whaling is prohibited over enormous tracts of sea. The whole Atlantic and Indian Oceans north of lat. 40° S. are closed to it, as is an extensive equatorial belt of the Pacific, The objects of this provision are the protection of calving grounds and the prevention of the destruction of whales when in their least productive condition. It may be possible in the light of further information more narrowly to define these areas, but their present extent guarantees a valuable protection.

The requirements of furnishing statistics and the regulations as to the payment of gunners are as in the previous practice of Norway and Great Britain.

The Agreement is for the coming season only, but there is provision for its year-to-year extension. It has been signed for the Union of South Africa, the United States of America, the Commonwealth of Australia, Germany, the United Kingdom of Great Britain and Northern Ireland and the Dominions, etc., the Irish Free State, New Zealand and Norway. It is to be hoped that other States will adhere to the Agreement: in particular, the adhesion of Japan would make its operation almost world-wide. The "Final Act" appended to the Agreement shows that the possible desirability of changes and extensions of its terms is fully recognized, and it is recommended indeed that next year, after the experience of a season's working, another conference should be convened to consider the Agreement in these respects. A very welcome recommendation is that Governments should take powers to regulate the methods of killing whales. There is reason to think that this would be in the interests of both economic working and humanitarianism.

J. O. B.

Obituary Notices

The Marchese Marconi

THE death of the Marchese Marconi from heart failure on July 20 deprives us of one who had taken the leading part in the development of world-wide communication. It is difficult to exaggerate the importance of his discoveries and the great effects they will have on the future history of the world. For communication purposes, he took the lead in helping to abolish space; and it is to be hoped that this, in the course of time, may result in the abolition of differences in language and even limitations of race. When sound and television are perfected in broadcasting, the outcome of early experiments in radio, life will surely be made easier for the masses, and Marconi's name will be kept green for hastening the advent of this blessing to humanity.

The early history of a great inventor is instructive; and luckily we have many accounts of Marconi's early life. One of the most interesting is the book by R. N. Vyvyan, formerly engineer-in-chief to Marconi's, entitled "Wireless over Thirty Years". For many years, Vyvyan was in close personal touch with Marconi and took a leading part in the great transatlantic transmission experiments.

Guglielmo Marconi was born in Bologna on April 25, 1874, his father being an Italian country gentleman and his mother the daughter of Mr. Andrew Jamieson, of Daphne Castle, County Wexford, Ireland. He was the younger of two brothers and was privately educated at Bologna, Florence and Leghorn. He attended Prof. Rosa's lectures on physics and studied the works of Prof. Righi. He was familiar with researches that had been made on Hertzian waves. While still a student, he was firmly convinced that just as flashes of light can be used to send signals by means of a heliograph, so, in an analogous way, electric waves could be used for signalling.

Marconi's earliest experiments were made in 1894 before he was twenty-one years of age. He used an induction coil as a Hertz emitter, and, at first, used a ball discharger of the type designed by Righi. It consisted of four brass balls separated by small gaps, immersed in 'Vaseline' oil. He connected one terminal of the secondary of the induction coil to a metal cylinder elevated to the top of a pole, and the other to a metal plate laid in the ground. He thus produced an elevated aerial which discharged across the spark gap to earth. At the receiving end he erected a similar capacity at the top of a pole and connected it to earth through a Branly coherer. He improved the design of this coherer, making it much more sensitive than anything previously made. In 1895 he employed metal cubes, the length of an edge being one foot. With this apparatus he was successful in receiving signals up to a distance of thirty metres. Doubling the height of the poles to four metres, he found that he could transmit to a hundred metres and quadrupling the height to eight metres, he transmitted to a distance of four hundred metres. He next increased the cubes so that their edges were about 3 ft. 3 in. in length. With this new aerial he was able to record Morse signals up to distances of about one and a half miles. He also tried the effect of concentrating the waves by means of large metal parabolic reflectors. This experiment was the forerunner of the beam aerials which came into use in later days when short electric waves were proved to be practicable.

In 1896, Marconi came to England and took out a patent, the first ever given for radio-telegraphy. In July of that year, Mr. Campbell Swinton introduced Marconi to Sir William Preece, the engineer-in-chief of the British Post Office. Sir William gave him every facility to carry out his experiments and with the help of the Post Office engineers, his system was successfully operated between the General Post Office and the Thames Embankment. The attention of the general public to the importance of Marconi's experiments was first attracted by the experiments carried out on Salisbury Plain, where reception over a distance of eight miles was demonstrated in the presence of officials of the Navy, Army and Post Office. In June 1897, Sir William Preece, in a lecture to the Royal Institution on "Signalling through Space without Wires", said that "Marconi had produced from known means a new electric eye, more delicate than any known instrument, and a new system of telegraphy which will reach places hitherto inaccessible". He also said that for shipping and lighthouse purposes it was a great and valuable acquisition.

In 1897, 'The Wireless Telegraph and Signal Company, Ltd.' was formed to acquire Marconi's patents. Three years later, the name was changed to 'Marconi's Wireless Telegraph Co. Ltd.' Marconi's next step was to erect a station at Alum Bay and another in Bournemouth. For this communication system he elevated his aerials to a height of about 120 feet and used a ten-inch spark induction coil. The Isle of Wight station was inspected by Lord Tennyson and Lord Kelvin, the latter paying for two radio messages. One of these, dated June 8, 1898, was to Sir William Preece at the G.P.O., London, and the other to Sir George Stokes.

In 1898, Prof. Slaby, of the Technical High School, at Charlottenburg, wrote an article on the 'new telegraphy' in the *Century* magazine. He pointed out that by a simple, but extraordinarily effective, method Marconi had raised the power of radiation a hundredfold. In collaboration with Count Arco, Prof. Slaby developed the Slaby-Arco system, but the German national wireless system—known as the Telefunken System—was not founded until 1903.

In May 1898, at the request of Lloyds' Corporation, apparatus was installed at Ballycastle and Rathlin Island in the north of Ireland. Uninterrupted communication was obtained, the lighthouse keepers quickly learning how to use the apparatus. About this period, Marconi greatly increased the range of transmission by inserting the primary winding of a small air core transformer in the aerial, the secondary windings being split by a condenser, the outer ends being brought to the terminals of the coherer. These transformers were called 'jiggers', and their efficiency encouraged Marconi to attempt to communicate across the Channel. The French Government gave permission to erect a mast at Wimereux. A corresponding mast was erected at the South Foreland Lighthouse and Marconi successfully transmitted messages on March 27, 1899. The Wireless Co. had established their works at Chelmsford and had erected a mast 150 feet high. Communication was effected between this station and Wimereux—a distance of 85 miles.

In the year 1900, the technical staff that the Wireless Co. had collected numbered only seventeen. Among them were Eccles, Erskine Murray and Andrew Gray, who was afterwards manager. In 1899, Prof. (now Sir Ambrose) Fleming had been appointed scientific adviser to the Company. The rapid increase in the range of radio communications had convinced Marconi that the curvature of the earth presented no obstacle to the extension of radio communication, and he decided to attempt to telegraph by his system across the Atlantic. In consultation with Fleming it was decided that the station for the transatlantic experiments should be built on the west coast of Cornwall. The site chosen was at Poldhu, on the west coast of the Lizard. In 1900, Marconi obtained his very important patent for 'tuned or syntonic telegraphy'. He used this method in his attempts to send signals across the Atlantic. He erected a station similar to Poldhu at Cape Cod in Mass., U.S.A. Unfortunately, the masts and aerial at Poldhu were wrecked by a storm, and a similar mishap at Cape Cod threatened to delay seriously the experiments. To save time when the Poldhu station was restored he went to Newfoundland and used a balloon to support his aerial. But as this was blown away, he used a kite as the support which, with great difficulty owing to a storm, was kept at a height of about 400 feet. He cabled to Poldhu to begin the pre-arranged programme, consisting of sending the Morse letter S (3 dots in succession) from 3 p.m. to 6 p.m. each day. On December 12, 1901, both he and his assistant repeatedly heard in their telephone the three clicks which proved that the electric waves had traversed the 1,800 miles separating St. John's from Poldhu.

In 1902, the site of a power station was chosen at Glace Bay in Canada, and when completed Marconi left England for Canada in an Italian cruiser, arriving on October 31, 1902. During the whole voyage he was receiving from Poldhu in the night time, but in the daytime he heard nothing after the distance was greater than 500 miles. When transmission was started, the early results were very disappointing. Later on, a site for a new station was found at Clifden, Ireland, and aerials were erected on a new principle Marconi had discovered. The Glace Bay and Clifden stations were opened for unlimited public service in February 1908. During the Irish rebellion, the Clifden Station was put out of action and a new station at Caernarvon in Wales was used instead.

Prior to 1916 it was generally accepted that for long-distance transmission long waves were essential. But in 1916 Marconi began his wonderful experiments on short-wave transmission, the wave-lengths being only about a hundredth of those usually employed. Erecting a small transmitting station at Poldhu, and fitting a receiver to his yacht *Elettra*, he found in 1923 that with a wave-length of 92 metres excellent reception could be obtained up to about 1,200 miles. The outcome of his work was that the Government accepted the Marconi Company's proposals to use the short-wave beam system for Imperial communications and started building stations capable of working with Canada, South Africa, India and Australia. Later on, in 1931, Marconi turned his attention to the systematic investigation of waves only about one metre in length. Using these waves, a transmission system was put into successful operation between the Vatican City and the papal palace at Castel Gaudolfo.

To the end of his life Marconi retained the vigour of youth. His love for experimenting never waned, and he infected his colleagues with his enthusiasm. He worked hard and was very successful in applying his theories.

Marconi married in 1905 the Hon. Beatrice O'Brien, daughter of Lord Inchiquin, who had been lady-in-waiting to the Queen of Italy. The marriage was dissolved by decree granted at Fiume in 1924. In 1927 he married the Countess Bezzi-Scali of Rome. He had one son and two daughters by his first wife and one daughter by his second.

During his lifetime Marconi's achievements brought him many of the highest honours which nations can bestow. His name is a household word all over the world. The patience and equanimity with which he bore the disappointing results obtained by many of his early laborious experiments will be for all time an encouragement to young engineering physicists.

Dr. H. H. Jeffcott

Henry Homan Jeffcott, who died on June 29, was born in Co. Donegal in the year 1877. In 1895 he entered Trinity College, Dublin, from the High School, Dublin, and had a very distinguished career there. In 1897 he obtained a senior exhibition at the final freshman examination, and in 1898 he was first mathematical scholar. In 1899 he graduated with a senior moderatorship in experimental science and a junior moderatorship in mathematics and a moderatorship prize. He spent the next year in London, and in 1900 returned to Trinity College and entered the Engineering School, where he obtained his engineering degree in 1902 with honours in all subjects. In the same year he won the McCullagh Prize for a treatise on the theory of elasticity.

Jeffcott spent the next few years in the shops of Armstrong Whitworth and Co., Ltd., and as assistant engineer with Siemens Brothers, and in 1905 went to the National Physical Laboratory and there became head of the Metrology Department. In 1910 he returned to Dublin as professor of engineering in the Royal College of Science for Ireland. In 1914 he became Dean of the College. During the Great War years his department was organized most successfully for the manufacture of munitions. In 1922 he received the degree of doctor of science of the University of Dublin. From 1918 until 1921 he was secretary to the Water Power Resources of Ireland Sub-Committee and took an active part in collaboration with Sir John P. Griffith, past president of the Institution of Civil Engineers, in the preparation of a scheme for the development of the water-power of the River Liffey. This scheme, though put on one side while the power resources of the Shannon were being developed, is now beginning to take practical shape under the ægis of the Electricity Supply Board.

In 1922 Jeffcott left Dublin for London on his appointment as secretary to the Institution of Civil Engineers, which position he filled until his death. His charming manner endeared him alike to his staff and the members of the Institution. He was very approachable and welcomed members who called on him, especially those home from abroad. His business ability and tact combined to bring to a successful conclusion many important negotiations with Government departments and public authorities. The recent reorganization of the Institution's activities brought much work to Dr. Jeffcott which the state of his health made very onerous. His early death, on June 29 at the age of sixty years, will prove a severe loss to the Institution and an irreparable one to those who had the good fortune to be his friends.

Though of exceptionally fine physique—Jeffcott was well over six feet in height and broad in proportion—he never took an active part in the athletic life of his college, though he thoroughly enjoyed a good game of tennis.

Jeffcott achieved considerable success as an inventor, being best known in this connexion through the Jeffcott direct-reading tacheometer. He was the author of papers on the vibrations of loaded shafts published in the *Proceedings of the Royal Society* and *Philosophical Magazine*, and of papers on water resources and other engineering subjects.

Miss Dorothy Sladden

By the tragic death of Miss Sladden in consequence of a motor accident on Saturday, June 20, a severe blow was struck at the science of experimental zoology. Miss Sladden was one of those rare people on whom Nature has bestowed an inborn love of animals and a marvellous skill amounting to genius in keeping them in good health and in inducing them to breed. She had not had a university education, but she was taken to the Imperial College by her parents as an occasional student, because they saw no other outlet for her peculiar abilities which had manifested themselves since she was quite a young girl.

After passing through the regular undergraduate course, at my suggestion Miss Sladden took up the question of the heritability of acquired habit and carried out with indomitable perseverance a series of experiments on this subject which extended over five years. She showed that the stick-insect (*Carausius morosus*) which is a native of southern India but which has been imported into Great Britain and is readily obtainable from dealers, could be induced by a series of periods of semi-starvation to accept a food (ivy) which was at first repugnant to it, and that the offspring of such insects accepted ivy more readily than did their parents, so that after five or six generations, 100 per cent of the insects accepted ivy at the first opportunity. In this species, males occur only at long intervals and the ordinary female is parthenogenetic, so that the complications involved in crossing different stocks are completely avoided. Two of her papers on this subject had already been published by the Royal Society, and a third in which she dealt successfully with objections which had been made to her first two papers, was nearly ready when a cruel fate snatched her away. Fortunately, this paper will be completed by our mutual friend, Mr. H. R. Hewer, who assisted and advised her in statistical matters.

It may be justly said that Miss Sladden has demonstrated beyond reasonable doubt that functional inheritance is a reality; and this is the cardinal question in zoology, indeed in all biology. Once this conviction has gone home, the whole course of evolution becomes clear and doctrines like the recapitulatory theory of evolution which have been fiercely fought over, follow as a matter of course. That functional inheritance must be true is a conclusion which had already been accepted by leading palæontologists and systematists in the British and other great museums, but the distaste for it felt by a certain modern school of biologists is so great that they refused to accept any but direct experimental evidence in its favour. This has now been provided by Miss Sladden, and it is a feat which will make her name live in the annals of zoology.

E. W. MACBRIDE.

WE regret to announce the following deaths:

Prof. E. B. Elliott, F.R.S., emeritus professor of pure mathematics in the University of Oxford, on July 21, aged eighty-six years.

Prof. W. T. Mather, professor of physics in the University of Texas, on June 14, aged seventy-two years.

Major Paul Murphy, formerly director of experiments, Chemical Warfare Station, Porton, on July 14.

Prof. S. C. B. Pennington, emeritus professor of agriculture in the University of Reading, on July 19, aged sixty-eight years.

Sir Charles E. Saunders, formerly Dominion cerealist, known for his work on the breeding of wheat in Canada, on July 25, aged seventy years.

Prof. Johannes Walther, emeritus professor of geology and palæontology in the University of Halle, on May 3, aged seventy-seven years.

News and Views

Sir Denison Ross, C.I.E.

THE retirement of Sir E. Denison Ross from the office of director of the School of Oriental Studies in the University of London, which he has held since the establishment of the School in 1916, has evoked numerous tributes of appreciation of his work as scholar and administrator, as well as of personal regard, which culminated at the dinner at which he was entertained as guest of honour on July 26. The fact that seven thousand students have passed through the School in the twenty-one years of its existence is sufficiently impressive, when it is remembered that before it came into being there were virtually no facilities for oriental studies in London; but these figures give only a very imperfect idea of the importance of the School as an Imperial asset. By adding Africa and its languages to the Orient in the stricter sense of the term, the School not only covers a broader field of scholarship than any other single institution of its kind, but it has also become a much valued, and indeed an essential agency in the training of officials, missionaries and others, whose life-work is, or will be, among the less advanced races of the Empire. This breadth of outlook and sense of public responsibility in the orientation of academic studies is largely due to the qualities and experience which Sir Denison Ross brought to the task of organizing and developing the work of the School. After a grounding in the study of oriental languages at Paris and Strasbourg, he travelled extensively in the Near, Middle and Far East, and acquired a knowledge of Asiatic languages and cultures no less extensive. This may be seen in his published works, which range from critical works of scholarship to appreciations of art and literature. Perhaps not the least scientifically interesting is a polyglot list of birds in Turki, Manchu and Chinese. No less important, however, than his gift of tongues was his educational and administrative experience during his thirteen years in Calcutta, which had proved and strengthened his ability to arouse enthusiasm for Oriental scholarship in others.

Prof. C. G. Cullis

AT the end of last year, Prof. C. G. Cullis retired from the chair of mining geology which he had held at the Imperial College of Science and Technology, London, since 1930. He became a student demonstrator in the Geological Department of the College so long ago as 1890, and was thus a member of the staff for nearly half a century, having been professor of mineralogy before he was appointed to the chair of mining geology. Prof. Cullis's former colleagues and students, many of whom are scattered over all parts of the world, recently assembled at the College to present an album to him containing their signatures, and to record their appreciation of his work and influence. In this tribute the subscribers say: "Generations of students will ever remember Professor Cullis as the ideal university lecturer. To few is given the skill to expound with such grace and effect the great truths of geology. We know the labour that is necessary for the attainment of apparent ease and simplicity: and here we see an apt example of *ars est celare artem*. But not only as a teacher will his students remember him: as a wise friend and mentor he was always accessible, and expert alike in directing their studies and in helping them to find their feet in the great world outside the College." In addition to the album, a cheque for the balance of the fund subscribed was presented to Prof. Cullis and a handsome electric clock to Mrs. Cullis and him jointly. Prof. Cullis has presented the cheque to the Governing Body of the College, with the suggestion that the income accruing from it should be used for the benefit of the mining geology department or students at the discretion of the professors of geology and mining geology department with the rector. The Governors have accepted this gift, and have resolved that the name of Prof. Cullis should be associated with the fund.

The Promotion of Peace

A petition to His Majesty's Government has been signed by a large number of distinguished people urging the Government to seek to avert the calamity of war by promoting an international inquiry into the fundamental causes of rivalry and unrest among the nations. The petition urges His Majesty's Ministers to take the initiative in this matter by inviting all other fully self-governing States, Dominions or Colonies to combine with Great Britain on equal terms in setting up expert commissions to ascertain and report upon the basic facts in regard to such questions as access to raw materials, and world markets, colonial development and the problem of surplus populations, foreign loans and credits, trade restrictions and international exchange. The signatories affirm their belief that if Great Britain showed an earnest desire to solve these problems, with full and impartial consideration of all just claims, her example would encourage the establishment of confidence and good will among the peoples of the world.

THE signatories of this petition include many heads of universities and colleges, more than one hundred fellows of the Royal Society, nearly as many distinguished writers as well as the archbishops, bishops and other Church leaders, and a number of members of Parliament. Representatives, individuals of all parties and officials of a large number of important organizations of all kinds throughout the country, have added their signatures, indicating the remarkable and extensive support which a representative body of opinion is prepared to afford the British

Government in the role of world peace-maker. The action already taken by the League of Nations, and approved by the Government, in promoting an inquiry into raw materials is obviously in line with the wishes of the signatories. The first essential step is to establish the facts in these matters beyond dispute, and the wisdom and urgency of this step are the more obvious in view of the refusal of certain countries to participate. If, in spite of such refusal, the British Government resolutely persists in a search for some way of reconciling the conflicting claims of different countries, convincing proof will be afforded of Great Britain's desire to promote peace based on a foundation secure because it is just.

Belfast Meeting of the British Medical Association

The British Medical Association held its one hundred and fifth annual meeting at Belfast last week under the presidency of Prof. R. J. Johnstone, professor of gynæcology in the Queen's University of Belfast. The main theme of his presidential address, entitled "Some Thoughts on Medical Education", was medical education, undergraduate and post-graduate. As a university teacher and member of the General Medical Council, Prof. Johnstone was able to speak with authority from practical experience. He said that the critic of medical education generally assumes that the teachers should, at the end of the five years curriculum, turn out the general practitioner as a finished product, and blames them if they do not do so, although no one expects a finished surgeon, anatomist or pathologist at the end of this period. The specialist must know almost everything about his subject, the general practitioner must know something about almost every medical subject, and the course the latter has to pursue cannot be less difficult than that needed by the former. Although clinical study must have a considerable place in the education of the undergraduate, it is a fallacy to consider that clinical training is the be-all and end-all of medical education. There must be an adequate background of human anatomy, physiology and pathology provided by medical education. Prof. Johnstone also alluded to the existence of dreary lectures and dull teachers, and suggested that courses of instruction in the art of lecturing might be instituted for those appointed to teaching posts.

Nutritional Requirements of Pregnancy

At a joint meeting of the Sections of Obstetrics and Gynæcology and Nutrition, a discussion took place on the nutritional requirements of pregnancy. Sir Robert McCarrison said that the food essentials needed by the prospective mother are, in order of precedence: (1) milk and milk products; (2) whole or lightly milled cereals, particularly good wholemeal or standard bread, and oatmeal; (3) green and leafy vegetables; (4) root vegetables, particularly potatoes, carrots and onions; (5) fruit, including the tomato; (6) pulses; (7) eggs; (8) meat, including fish, fowl and glandular organs. To these should be added, in Great Britain, a daily teaspoonful dose of cod liver oil; a portion of yeast extract is a wise precaution. Dame Louise McIlroy also stressed the value of fresh fruit and vegetables, herrings and wholemeal bread. She suggested that lessons and demonstrations in the preparation and storage of food might well form a part of the work of ante-natal clinics. Other speakers also emphasized the importance of an adequate supply of vitamins during pregnancy. The incidence of puerperal pyrexia seems to be diminished by these means.

Maiden Castle, Dorchester: Excavations in 1937

Excavations have now been resumed at Maiden Castle, Dorchester, under the direction of Dr. R. E. Mortimer Wheeler and Colonel C. D. Drew on behalf of the Society of Antiquaries and the Dorset Natural History and Archæological Society (*The Times*, July 26). Three areas are to be explored in the coming season. At the eastern entrance, the unexpected discoveries made last autumn towards the close of last season's work will be further examined. These earlier fortifications, partly of masonry and dating from the third century B.C., which were found beneath the earthworks screening the entrance, include two outer gateways, which with the inner gateway constitute a complex plan hitherto unknown in prehistoric fortifications. Outside these are areas in which iron was smelted and burials took place. The latter should afford further evidence of the physical characters of the inhabitants, who according to the skeletons found last year were of a small build. Within the fort, investigations will be directed firstly to the Neolithic trenches found last year near the temple, which may have been part of the inner defensive system of the Neolithic partial occupation of *c.* 2000 B.C.; and secondly to the original western entrance, which was found in December last, but was not then explored. This last is marked by a gap in the rampart, which shows the original western limit of the castle, and should reveal the plan of the earliest gateway known. The first important discovery of the season is that of approach roads diverging in a north-easterly and south-easterly direction, which were superseded and abandoned in the first century B.C. and are thus among the earliest metalled roads known in Britain.

Evidence of Early Man at Bethlehem

To the antiquities from Tell Duweir on view at the Wellcome Research Institution (see Nature, July 17, p. 99) have been added, since the opening of the exhibition, finds from the Bethlehem Bone Beds, which are being excavated by the Wellcome Marston Archæological Research Expedition to the Near East. The work of investigation is being carried out by Miss D. Bate and Miss E. Gardner. The great pit, from the clays of which these finds are derived, appears to be a swallow hole. Rock has been reached on two sides, while on the third side what appears to be only a thin sheet of sloping deposits remains; but until bottom has been reached the exact form cannot be determined. There are indications that the cavity may fork as deposits are followed further. Among the animal remains found in 1937, the most striking is the hinder part of the carapace of a gigantic tortoise, together with some detached plates and a bone of the same species. By way of contrast is the fossilized bone of a diminutive species of tortoise. There are also shown part of the tooth of an elephant—the first identification of an elephant in Palestine was from this site—the upper cheek-teeth of a rhinoceros and evidence of a very small form of horse, new to the fauna of Bethlehem. Although there has not yet been opportunity to identify the species with certainty, the indications point to a probably Lower Pleistocene horizon, or even possibly Pliocene. With the animal remains are shown flints selected from a larger number which were found in the bone beds and associated with the fossil fauna. Of these, one is apparently a core, while the others are of characteristic Eolithic or pre-Palæolithic forms. Both the character of the flaking and the forms would seem to place their human origin beyond question. Their association with the animal remains in a definite geological horizon constitutes them the earliest evidence of man's existence yet discovered in Palestine. The exhibition will close on August 7.

"Caves and Caving"

THE British Speleological Association, which met for its second annual conference at Bristol on July 23–26, may now be regarded as fully established. It has acquired Cragdale House, Settle, Yorks, for its headquarters—a 'shilling fund' to raise £500 has been initiated for its equipment by the women members—and it has issued the first number of a publication under the title "Caves and Caving" (1*s.*, annual subscription 4*s.* 6*d.*), in which speleological studies will be treated scientifically, but in popular form. The first issue opens with Sir Arthur Keith's presidential address "History from Caves", delivered at Buxton last year, fronted by an excellent portrait of the author; Prof. L. S. Palmer follows with an account of the objects of the Association and its work up to the present, the latest undertaking to which he refers being the systematic study of the aquatic fauna to be found in cave streams; Mr. E. Simpson reviews the life-work in speleology of the veteran, M. E. A. Martel, honorary member of the British Speleological Association, and honorary president of the Spéléo Club de France at its foundation in 1930. Mr. A. Leslie Armstrong counsels caution in "Cave Exploration as a Science"; and Dr. Franco Anelli gives an account of the recent descent into La Preta Cavern in the Lessini Mountains of the Veronese, Italy, the deepest known cave in the world, when a depth of 637 metres (approximately 2,090 ft.) was reached. At the recent field meeting of the British Speleological Association at Gaping Ghyll Hole, Ingleborough, Yorks, 356 descents were made and half a mile of new passages were explored. This is Britain's largest cave. The history of its exploration is reviewed by Mr. E. Simpson in a contribution, to be continued. Among other articles is a first instalment of the extremely valuable record of cave finds, arranged under caves, which is being compiled through inquiry by Dr. Wilfrid Jackson. It will, when complete, show the present location, museum or other, of all animal remains and artefacts of archæological interest found in British caves, so far as can be ascertained.

New Penguin-breeding Record at Edinburgh

THE Scottish National Zoological Park at Edinburgh has long been famous for its penguins—not only for their number and variety and fine condition but also for the manner in which they have bred there. The king penguin bred first in the Park eighteen years ago, and since that time fifteen king penguin chicks have been bred and reared. The ringed penguin and the rockhopper penguin both bred in the Park two years ago. These were the first occasions on which these three species have bred in Britain, and probably the first time they have bred in captivity anywhere. The latest achievement of this kind is the breeding of the gentoo penguin. The gentoo penguin comes next in size to the king penguin. While the king penguin makes no nest but holds its single egg on its feet during incubation, and the rockhopper penguin and ringed penguin make a rough nest of a heap of pebbles, the gentoo penguin prefers something softer, and collects dead grass, twigs and small sticks which it shapes into a symmetrical nest. It was nearly two months after the beginning of the nest building that the first egg was laid, and a second egg was laid five days after the first. Both parents shared in the work of incubation, and took their turns fairly regularly. The first egg hatched after an incubation period of five weeks and four days, but the second was infertile. The chick has a nestling coat of pale grey on the back and white underneath, and it was observed to feed on the day it hatched. It feeds, as do all 'baby' penguins, by taking partially digested fish from the throat of the parent bird.

Acquisitions at the British Museum (Natural History)

MR. J. L. CHAWORTH-MUSTERS has presented to the Department of Zoology 82 birds belonging to 31 species, and a few field mice, which he collected in the High Atlas Mountains, above Marakesh, in the early part of the year. Included among the birds are examples of the rare crimson-winged finch, an alpine accentor, and local forms of the dipper and shore lark. The Entomological Department has received a welcome gift in the letter-book of Dru Drury, a famous collector and describer of insects (1725–1803). He was a goldsmith living in London who had correspondents in Asia, Africa, America, and Australia. This book contains copies, in his own hand, of letters written by him to his friends, his collectors, and his business connexions during the years 1761–1780, and gives a valuable insight into entomological proceedings during that period. Accompanying this volume, and similarly presented by Mr. Charles Dru Drury, are a copy of the auctioneer's catalogue of Dru Drury's collection (1801), and a small collection of letters addressed to him by Carl Linné the younger, by A. R. Lewin (from Australia), and by other well-known contemporary naturalists.

Accessions in the Department of Geology include a collection of nearly 200 fossil fruits and seeds from the Cromer forest bed, all described and figured by Mrs. E. M. Reid and her late husband Dr. Clement Reid, and now generously presented by Mrs. Reid. The Trustees approved the purchase for the Department of Minerals of a nugget of well-crystallized iridosmine (osmiridium), weighing nearly an ounce, from Adamsfield near the source of the Derwent in Tasmania. There is a larger nugget already in the collection weighing nearly two ounces and reputed to be the second largest nugget of pure iridosmine, but it is less well crystallized than the specimen now acquired. Other important purchases are a slice weighing 1,387 grammes of a rare type of meteorite—a pallasite—from Springwater, Sascatchewan, a fine aurichalcite from Utah, and a fine group of laumontite and a large crystal of adularia from northern Italy.

Televisor, Telegraphy, Telephone

The word 'Televisor' was coined by Mr. J. L Baird in 1925 to describe apparatus for television and was registered by him as a trade mark. On account, however, of the general adoption of the word in the United States and elsewhere to denote any kind of television apparatus, Baird Television, Ltd., has decided to abandon its registration as a trade mark, so that in future there will be no restriction upon the use of the word in connexion with television. 'Televisor' may thus be used in future as freely as 'telegraph' and 'telephone'. The word telegraph was first applied by Chappe in France, in 1792, to his invention of the semaphore system of transmitting messages to a distance; and the word telephone was used by Sudré in 1828 for a system of signalling by musical sounds. It was employed in 1844 to describe a powerful wind instrument to convey signals at sea during foggy weather. Philipp Reis, in 1861, called his ingenious instrument a telephone, so that he may be regarded as the inventor of the name of the modern instrument. Alexander Graham Bell adopted the word in 1876 for his "Electrical Speaking Telephone".

The Earl's Court Exhibition Centre

The new Earl's Court Exhibition building, erected on the site of its predecessor, is approaching completion. It will be the largest permanent exhibition and sports centre in the British Isles. The site covers approximately twenty acres, the new buildings enclosing nine acres. The main arena is unique, as it is the largest concrete building in the country. There are no less than six electric railway tracks running underneath the site of this exhibition. These tracks were covered in by tunnels or bridged without interrupting the railway services. The main hall itself is 250 feet by 350 feet without columns, and has seating accommodation for about 25,000 people. A swimming pool having a capacity of 2¼ million gallons of water is provided. An account is given in the *Electrical Times* of July 1 of the problems connected with the heating and lighting of the exhibition. Complete designs and estimates were got out for all reasonable methods of doing this. The first step taken was to prepare designs and costs for a complete generating power station for the Exhibition and alternatively to use boiler-house plant for heating purposes. This was compared with possible tariffs obtained from the Fulham Power Station for an electric service for lighting power and complete heating of the building by electric thermal storage. The estimates were considered by the Company and its consultants, the conclusion being that electricity for all purposes was the best scheme. The Fulham Borough Council has undertaken to carry out the complete installation of all the electrical plant and services required up to the point of low-tension distribution together with the electric thermal storage plant, and the work is now on the point of completion. A permanent form of fire-fighting equipment is installed at every substation. The heating of the whole of the building is carried out by an electric thermal storage hot water plant which is much the largest plant of this kind in the British Isles.

History of Alchemy

There are welcome signs of an awakening interest in the history of science, the study of which has until recently received surprisingly little recognition among the increasing body of scientific workers in Great Britain. The appearance last year of *Annals of Science*, a quarterly journal devoted to the history of post-Renaissance science in general, has been quickly followed by another publication entitled *Ambix*, which is to deal with the specialized study of alchemy and early chemistry. *Ambix* is, indeed, the official journal of the newly founded Society for the Study of Alchemy and Early Chemistry. The first issue is dated May 1937; the second number will appear in November 1937; and thereafter it will be published as a quarterly. At first sight, the subject may appear too restricted to afford material for a quarterly periodical, but this impression is corrected by supplementary glances at Sir Robert Mond's introduction and the later contents of this issue. "Alchemy," writes Sir Robert, "records not only Man's groping for the truth and for the enrichment of his experiences, but at the same time the widening of the Human Mind and the accompanying evolution of thought."

Another point of view is presented by Prof. J. Ruska in his contribution on "Methods of Research in the History of Chemistry". Here he states that "we continually need new texts, we need summaries of contents, translations and commentaries . . . we need also the application of the keenest critical methods." *Ambix* has already begun to supply material of this kind. Thus, Prof. J. R. Partington contributes a fully documented article entitled "Albertus Magnus on Alchemy"; Dr. F. Sherwood Taylor, the editor, writes upon "The Origins of Greek Alchemy"; Mr. Gerard Heym opens a useful "Introduction to the Bibliography of Alchemy", and also discusses the "*Aurea Catena Homeri*". There are, in addition, a report of a discussion upon chemical and alchemical symbolism; a translation of "The Visions of Zosimos", by Dr. Taylor; and reviews of four recent books, including notably Prof. Partington's "Origins and Development of Applied Chemistry" and Prof. J. Read's "Prelude to Chemistry". The nature of these two works, differing so widely in scope and treatment, conveys some idea of the ambit of *Ambix*.

Public Health in British India during 1934

THE annual report of the Public Health Commissioner with the Government of India (vol. 1), recently issued, surveys the vital statistics, public health and public health services of British India for the year 1934 (Government of India Press, New Delhi, 1936. Rs. 6 As. 2, or 10*s*.). The mid-year population is estimated to be 275,753,570, the births were 9,288,897, a rate per 1,000 of 34, and the deaths numbered 6,856,244, a rate per 1,000 of 25. The infant mortality per 1,000 live births was 187. Of the causes of death, malaria heads the list with 1,319,026 deaths, and this figure does not include the mortality caused indirectly by malaria. Deaths from respiratory diseases numbered 483,018, those from dysentery and diarrhœa 285,110 and from cholera 199,708. Smallpox, with 83,928 deaths, caused a greater mortality than plague, with 80,131 deaths. At the Research Institute, Kasauli, a number of cases of snake-bite have been treated with antivenomous serum with a high percentage of recoveries —25 out of 29 cases of cobra bite, and 12 out of 13 cases of bite by Russell's viper. Lieut.-Colonel Jolly, the Commissioner, believes that the intensive public health propaganda carried out during the last ten or twelve years is beginning to bear fruit, and that interest is increasing in such matters as rural reconstruction, nutrition, child welfare and the prevention of epidemics.

Examinations in the United States

EXAMINATION, as a teacher's tool, has undergone remarkable modification in the past sixteen years in the United States. The search for an instrument of precision for the use of teachers in examining their pupils has engaged the ingenuity of a host of investigators, and the resultant devices, the true-false, the completion, the matching, the multiple-choice, the one-word, the problem and other objective-type tests have, to a large extent, supplanted the essay test. The United States Office of Education has recently issued a report (Bulletin 9/1936, Washington: Supt. of Documents. 10 cents) on testing practices of secondary school teachers of 1,600 schools, as described by themselves. It appears that, when constructing tests, about seventy-four per cent of them make use principally of the objective type, only sixteen per cent rely chiefly on the essay test and ten per cent make equal use of both. The report shows that the new style of tests is popular with teachers. Their simplicity appeals to them. But it is clear that their employment calls for watchful control. A principal advantage claimed for them—that a large number of items can be answered in a short time and the subject-matter can thus be the more thoroughly sampled—has been unrealized in many cases through not using a sufficient number of questions. Of intelligence tests, the report says that few teachers really use the results.

The Swiss Earthquake Service

THE Swiss Seismological Commission, afterwards the Swiss Earthquake Service, is the oldest committee engaged in the study of earthquakes. For its foundation in 1878, we are indebted to the veteran geologist, Prof. Albert Heim. Two years later, it was followed by the British Association Committee on earthquakes in Japan, which, on Prof. Milne's return to Great Britain in 1895, enlarged its scope as the Seismological Committee. In 1883, shortly after the destructive Ischian earthquake of July 28, a geodynamic section was added to the Central Meteorological Office at Rome, which still carries on its useful work of studying Italian and other earthquakes; and, in 1892, the Imperial Earthquake Investigation Committee began its similar, but more extensive, work in Japan. The Swiss Committee, under the direction of Dr. E. Wanner, has recently issued its *Jahresbericht* for 1935, containing three valuable tables, the first on earthquakes sensible in Switzerland, twenty-seven in number, none of which reached destructive intensity; the second, of eighty earthquakes with origins as a rule less than three hundred miles distant; and the third, of a hundred and fifty earthquakes recorded at the five Swiss stations (Zurich, Chur, Neuchâtel, Basel and Sion), the distances of the origins being not less than six hundred miles.

Discussion on Lubrication and Lubricants

THE Council of the Institution of Mechanical Engineers, with the co-operation of other societies and institutions, has decided to hold a general discussion on lubrication and lubricants on October 13–15, when a series of some 140 papers from leading authorities throughout the world will be presented. The opportunity will be taken to review the present state of knowledge by means of a general discussion among those especially interested and qualified to discuss the major problems of the subject, with objects such as to endeavour to establish a correlation between theory and practice and to show how bearing design can be applied, to relate academic research with trade practice, to obtain current views upon bearing metals, and to review the significance of laboratory tests, including wear and friction tests. An exhibition will be held at the Science Museum, South Kensington, to illustrate the subjects under discussion, and will be devoted to lubricants, bearings and bearing materials, as well as to testing and other apparatus. The exhibition will be open for a fortnight from October 13. Support for the discussion has been given by twenty-nine British societies and technical institutions and by ten over-seas societies and technical bodies. The complete proceedings will be issued as a bound volume. Advance copies of the papers will be available for use at the meetings.

Application forms for tickets of admission and for copies of papers, and further information about the discussion may be obtained from the Secretary, Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.

A Naked-eye Group of Sunspots

A VERY large group of sunspots, that is likely to develop into the largest group so far recorded during the present eleven-year cycle, came into view at the sun's east limb on July 22 in latitude 31° N. The date of central meridian passage is July 28·5; on August 4, the group will reach the sun's west limb. The group comprises a large leader spot and a follower of composite structure; these, with companion spots, covered no less than 2,000 millionths of the sun's hemisphere on July 24. On July 26 (the date of this report) the two chief component spots could be distinguished separately with the naked eye.

The Night Sky in August

THE moon is new on August 6 at $12{\cdot}6^{h}$ and full on August 22^{h} at $0{\cdot}8^{h}$ U.T. Conjunction with the planet Venus occurs on August 3 at 9^{h}, and from the northern part of England and in Scotland an occultation can be seen (see NATURE, July 17, p. 103). On August 18 at 23^{h}, there is a conjunction with Jupiter, and on August 24 at 20^{h} a conjunction with Saturn. On August 30, the moon occults the 5th magnitude star, ο Tauri, the re-appearance at Greenwich taking place at 3^{h} 20^{m} at position angle 314° from the moon's north point. From sunset until sunrise during August, four bright planets are visible. Mars sets before midnight; Jupiter is on the meridian at $21\frac{3}{4}^{h}$ in the middle of the month, followed by Saturn at $2\frac{3}{4}^{h}$: whilst Venus rises at about $1\frac{1}{4}^{h}$ and is a brilliant object in the early morning skies, passing between Procyon and Castor and Pollux towards the end of the month. Uranus is nearly stationary in Aries and may be picked out from the background of stars of similar magnitude (about 6^{m}) with the help of the map given on p. 57 of the B.A.A. Handbook. At about 21^{h} the constellations on the meridian offer almost unlimited scope for interesting 'sweeps', which should include double stars such as α Herculis, θ Serpentis, β Cygni, γ Delphini and δ Cephei. The latter star is a notable short-period variable giving its name to a class of variable which, recognizable in the nearer extra-galactic nebulæ, enables the distances of these remote systems to be determined. Of the nebulæ and star clusters to be viewed with binoculars or a small telescope, the 'ring' nebula in Lyra, the 'dumb-bell' nebula in Vulpecula and the star cluster in Hercules should be easily located by means of a star atlas. The general outline of the Milky Way may also be studied with binoculars, noting the bifurcation near the bright star, Deneb, and the star clouds near the southern horizon. It may be recalled that towards a point at R.A. 18^{h} 4^{m}: Dec. +31° the solar system is moving into space with a speed of 12 miles a second. Between August 10 and 12, in particular, the sky may be watched for meteors of the Perseid stream. An ephemeris for the comet Grigg-Skjellerup is given on p. 32 of the B.A.A. Handbook and, also one for the comet Encke, which may possibly be picked up before long on its return to perihelion due next December. The periodicity of this comet, only 3·3 years—the shortest known period for a comet—was first recognized by Encke in 1819.

Announcements

The Earl of Rothes has accepted the appointment of chairman of the governors of Faraday House Electrical Engineering College, in succession to the late Lord Castletown.

DR. L. J. SPENCER, formerly keeper of minerals in the British Museum, has been elected a corresponding member of the Société Géologique de Belgique.

PROF. L. J. WITTS, professor of medicine in the University of London and physician to St. Bartholomew's Hospital and Prof. G. E. Gask, emeritus professor of surgery in the University of London, have been appointed members of the Medical Research Council, in succession to Sir Thomas Lewis and Sir David P. D. Wilkie, who retire on September 30.

THE Trustees have appointed Dr. S. Ochoa of the University of Madrid as Ray Lankester investigator for 1937, and Dr. Ochoa began his researches at the Marine Biological Association's laboratory in Plymouth on July 1, his subject being the experimental relationship of structure to environment in fishes and other animals. This work is a continuation of previous researches at Madrid and Heidelberg on the same subject.

THE first International Congress of Medical Public Health Officers organized by the syndicate of French medical hygienists under the auspices of the Health Section of the League of Nations will be held in Paris on October 20–21 under the presidency of Prof. J. Pariset. Further information can be obtained from Voyages Duchemin-Exprinter, 26 Avenue de l'Opéra, Paris 1e.

THE twenty-ninth Annual Autumn Meeting of the Institute of Metals will be held at Sheffield on September 6–9. On September 6, Dr. D. R. Pye, deputy director of scientific research, Air Ministry, will deliver the sixteenth Autumn Lecture entitled, "Metallurgy and the Aero Engine". Further information can be obtained from the Secretary, Institute of Metals, 36 Victoria Street, London, S.W.1.

THE fourteenth annual conference of the Association of Special Libraries and Information Bureaux (ASLIB) will be held at Gonville and Caius College, Cambridge, on September 24–27, under the presidency of Sir Harry Lindsay, director of the Imperial Institute, who will give an address on "The Inter-relation between Science, Agriculture and Industry". Further information can be obtained from the General Secretary, ASLIB, 31, Museum Street, London, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 200.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Some New Types of Pleochroic Haloes

EXAMINATION of a large number of biotite specimens from all parts of the world by my students and myself[1] has shown the existence of six distinct types of pleochroic haloes. Two of these, the common type due to uranium and the rarer thorium type, arise from parent radioactive elements of such long periods that α-rays are still being emitted and the darkening of the ring structure is still progressing in these haloes. The remaining four types appear to arise from parents of such short periods that all activity must have long since ceased. The first two types may be referred to as 'active' haloes and the last four as 'extinct' haloes.

To avoid premature implications as to their origin, the extinct types will be designated as *A*, *B*, *C* and *D*. The *A* type is similar to that described by Joly[2] as "emanation haloes". Types *B*, *C* and *D* are believed to be new. A photomicrograph of a *C* type halo is shown as an example in Fig. 1.

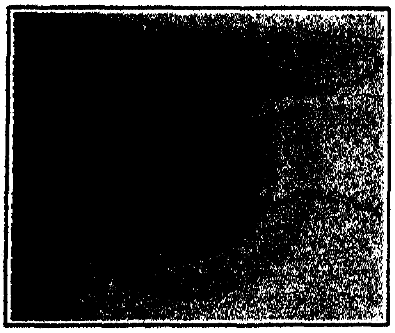

Fig. 1.

The *A* type has one ring, *B* has two rings, *C* three rings and *D* one ring. Certain subsidiary rings, mainly due to the actinium family, are occasionally found. The results of measurements of ring radii with the halo photometer are shown in the accompanying table.

Type	Ring radius in microns	Associated α-particle	Number in group
A	19·60	Po	62
B	34·49	RaC′	24
	20·00	Po	24
C	34·59	RaC′	23
	24·08	RaA	25
	19·86	Po	21
D	16·21	Ra	26

In the third column is shown the α-particle, the range of which agrees with the ring radius within the limit of experimental error and which appears to be the most probable parent of the halo ring in question. The fourth column shows the number of rings actually measured on the photometer records of a limited number of very good haloes mounted on slides and sorted out as to type by visual inspection.

It is to be noted that all six types of haloes may be accounted for by known radioactive elements, and that the ring radii appear to be constant in haloes contained in minerals of all geological ages.

The extinct haloes are fairly common, except type *D*, which is rather rare. All have been observed in more than one biotite specimen. Compound haloes are also found which are due to the superposition of two extinct types, notably *A* and *C*. Extinct haloes are often found arranged along irregular lines the course of which has little relation to the crystal directions. Often a distinct narrow channel is visible, which passes through the centres of the haloes and is sometimes surrounded by a faintly darkened tubulation the radius of which is that of the haloes.

It seems clear that an explanation of the mode of formation of these new types of haloes lies in hydrothermal action, but a detailed consideration is beyond the scope of this letter. A full account of these haloes and a discussion of the mechanism of their formation will be given shortly elsewhere.

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Halifax, N.S.
June 12.

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[1] *Proc. Roy. Soc.*, A, **145**, 563, 582 (1934); **158**, 199 (1937).

[2] *Phil. Trans.*, **217**, 51 (1917).

Colchicine, 'Phytocarcinomata' and Plant Hormones

COLCHICINE has been shown to produce a bulbous hypertrophy of the root tips and coleoptile of wheat seedlings[1]. In these swellings, the appearance of the mitotic figures closely resembles those found in certain organs of animals treated with colchicine, and also in malignant tumours of animals[2,3]. In this respect, the action of colchicine appears to be similar to that of *B. tumefaciens*, which causes the 'phytocarcinomata'. On the other hand, A. P. Dustin[4], Amoroso[5] and Peyron *et al*[6] have claimed that colchicine inhibits the growth of malignant tumours in animals.

I have tested the effect of colchicine on the growth of tumours in plants by the following method. Seventy tomato plants (var. Kondyne red), grown in pots, were inoculated on the same day, with a virulent strain of *B. tumefaciens*, five inoculations being made on the main stem of each plant. The plants were then divided into five groups. One group was used as a control; colchicine was tested on another group; and the other three groups were used for experiments that I shall mention later.

Colchicine in a 1 : 10,000 aqueous solution was introduced through a cut in the stem, by a method I have previously described[7]. On the average, 2·5 mgm. of the substance was absorbed by each plant during the period March 18–May 14, 1937. The accompanying table shows that the effect of this treatment was an inhibition of the growth of the tumours in the inoculated plants.

The other three groups of plants were used in control experiments, designed to test the possibility that hormonal changes in plants influence the growth of plant tumours. An attempt was made to influence the plant hormones by the following three methods:

(1) I excluded light from the terminal buds of one group of plants by capping them with a black cloth[8], on the grounds that the influence of light on the elaboration and circulation of growth hormones in plants is well known.

(2) In another group I removed the flowers, because this also influences the elaboration and circulation of plant hormones.

(3) I administered palmitic acid to the last group of plants, because palmitic acid, administered to animals simultaneously with sex hormones, increases the effect of the hormones[9]. The substance was administered to the plants in two successive doses of 10 ml. of a 5 : 1,000 solution per plant, and the solution was poured directly on to the soil. The experiments were carried out in ordinary greenhouse conditions (the greenhouse was generously put at my disposal by Madame A. Fester, of Antwerp).

Number of plants	15	10	10	5	30
Treatment	Colchicine	Capped terminal buds	Flowers removed	Palmitic acid	Control
Average weight of tumours per plant	1·173 gm.	1·345 gm.	2·083 gm.	1·510 gm.	3·406 gm.
Average weight of one tumour	0·211 gm.	0·206 gm.	0·277 gm.	0·228 gm.	0·444 gm.
Average number of tumours per plant	5·53	6·50	7·50	6·60	6·85

The table shows that all these three types of treatment produced inhibition of the growth of the plant tumours, and it is therefore suggested that inhibition was produced by a hormonal alteration. The possibility therefore cannot be excluded that colchicine inhibits the growth of plant tumours in a similar way, namely, through the intervention of the plant hormones.

LÁSZLÓ HAVAS.

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University, Brussels.
June 20.

[1] Havas, L., NATURE, 139, 371 (Feb. 27, 1937).

[2] Dustin, A. P., Havas, L., and Lits, F., *Réunion Assoc. Anatomistes, Marseille*, 1937.

[3] Dustin, A. P., *Arch. port. sci. biol.*, 5, 38 (1936).

[4] Dustin, A. P., *Bull. Acad. roy. méd. de Belgique*, 14, 487 (1934).

[5] Amoroso, E. C., NATURE, 135, 266 (Feb. 16, 1935).

[6] Peyron, A., Lafay and Kobozieff, *Bull. ass. fr. p. étude du Cancer*, 25, 874 (Déc., 1936.)

[7] Havas, L., *C. R. IIe Congrès intern. lutte sci. contre Cancer, Bruxelles*, 1936.

[8] Zimmerman, P. W., and Hitchcock, E., *Con. Boyce Thompson Inst.*, 8, 311 (1936).

[9] Miescher, K., A. Wettstein, and Tschopp, E., *Schweiz. med. Wochenschr.*, 66, 1, 310 (1936).

Interaction of Nuclear Particles

FOLLOWING the results of scattering experiments, the hypothesis is now generally favoured[1] that the interaction forces in nuclei do not depend on the charge of the particles concerned. Then the general interaction potential for two particles 1 and 2, either of which may be a proton or a neutron, can be expressed as:

$$U_{12} = [W + \tfrac{1}{2}B\{1 + (\sigma_1\sigma_2)\} - \tfrac{1}{2}H\{1 + (\tau_1\tau_2)\} - \tfrac{1}{4}M\{1 + (\sigma_1\sigma_2)\}\{1 + (\tau_1\tau_2)\}]J(r_{12}) \qquad (1)$$

Here σ_i is the spin vector of the particle i and τ_i the formally analogous "isotopic spin vector"[2]; τ_{iz} has the value $+1$, if i is a proton, and -1, if i is a neutron; W, B, H and M are four constants. From (1) we obtain $(W + B + H + M)J(r)$ as the potential in the ground state of the deuteron. If $J(r)$ is correspondingly normalized we may put:

$$W + B + H + M = 1 \qquad (2)$$

The value of the energy of the singlet state, as derived from scattering experiments, is then accounted for very closely if we put:

$$W - B - H + M = \tfrac{1}{2} \qquad (3)$$

Other relations between the four constants may be obtained from the consideration of heavy nuclei. As Breit and Feenberg[3] first showed, the fact that heavy nuclei with extremely large binding energies do not exist is explained if we put:

$$a_1 = 4W + 2B - 2H - M \leq 0 \qquad \text{(i)}$$

Further, since heavy nuclei of zero charge are experimentally unknown, we must have

$$a_2 = 2W + B - 2H - M \leq 0 \qquad \text{(ii)}$$

Further considerations by Volz[4] led him to conclude that a_1 is very nearly zero (which is in agreement with the results of Inglis[5]), and also that a_2 is very nearly equal to 0. Taking $a_1 = a_2 = 0$, the four constants were then completely determined by Volz.

An additional requirement has hitherto apparently been overlooked: all known nuclei show a very large degree of spin-neutralization. Even in the heaviest nuclei, the total spin never exceeds about $10(h/4\pi)$. Heavy nuclei, in which the spin moments of practically all the particles are parallel, must certainly be unstable. This leads to another condition, namely,

$$a_3 = 2W + 2B - H - M \leq 0 \qquad \text{(iii)}$$

This inequality can immediately be deduced by analogy with (ii). One has only to note that (1) is invariant if σ, B and τ, $-H$ are interchanged.

Condition (iii) is not satisfied by the values of the four constants derived by Volz. The assumptions $a_1 = a_2 = a_3 = 0$ lead to equal energies for the triplet and the singlet states of the deuteron, in definite disagreement with experiment. One can satisfy all three conditions (i–iii) only by taking $a_2 \leq -\tfrac{1}{4}$. The limiting value $-\tfrac{1}{4}$ is, however, outside the limits for a_2 inferred by Volz. A negative value for a_1 would not give better agreement.

Note added in proof.

The manuscript of this note was sent to Dr. Volz, who kindly pointed out that the value $a_2 = -\tfrac{1}{4}$ may be considered as just within the limits of his estimate. Dr. Volz, however, agrees that the values of the force constants calculated under the assumption $a_1 = a_2 = 0$ are shown by the above considerations to be improbable; the choice $a_1 = a_3 = 0$ should be more accurate.

N. KEMMER
(Beit Scientific Research Fellow).

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London, S.W.7.
June 18.

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[1] Breit, Condon and Present, *Phys. Rev.*, **50**, 825 (1936).

[2] Cassen and Condon, *Phys. Rev.*, **50**, 846 (1936).

[3] Breit and Feenberg, *Phys. Rev.*, **50**, 850 (1936).

[4] Volz, *Z. Phys.*, **106**, 537 (1937).

[5] Inglis, *Phys. Rev.*, **51**, 531 (1937).

Infra-red Spectrum and Molecular Structure of Diketopiperazine and Tetramethyldiketopiperazine

SANBORN[1] has concluded from her work on the chemical properties of glycine anhydride (diketopiperazine), that the molecule exists only in the enol-form (I). In view of the importance of the diketopiperazine configuration for the knowledge of the structure of the proteins, it seemed not without interest to look for further means of investigating the molecular structure of this substance. A very suitable method is the analysis of the infra-red spectrum. The absorption bands of diketopiperazine and its tetramethyl derivative were therefore observed with a quartz spectrometer in the region 2·8–3·6 μ. The effective slit-width was 0·02 μ. Each substance was deposited from a suspension in alcohol or ether, respectively, as a crystalline layer on the quartz window of an absorption cell. Following a suggestion of Dr. W. T. Astbury, the cell was then dried *in vacuo* over phosphorus pentoxide for 38 hours, so as to eliminate all traces of water which might have been adsorbed on the surface of the crystals. The cell was kept dry with phosphorus pentoxide throughout the course of the experiments.

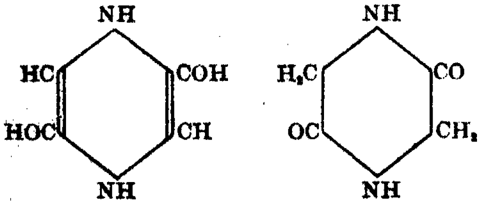

Fig. 1.

The results are given in the accompanying table. The accuracy of the wave-length measurements is ± 0·003 μ.

ABSORPTION BANDS OF DIKETOPIPERAZINE AND TETRAMETHYLDIKETOPIPERAZINE

Diketopiperazine (λ in μ)	Tetramethyldiketopip. (λ in μ)	Assignment of bands to vibrations of molecular groups
2·928 2·953	2·964 2·983	Valence vibration of C=O groups, first overtone.
3·008	3·013	Valence vibration of N–H groups, fundamental.
3·478 3·525	3·480 3·538 3·569	Valence vibrations of $-CH_2$ (column 1) and $-CH_3$ (column 2) groups, fundamental.

The assignment of the bands to the molecular groups given in the table may be understood by reference to the formulæ, of which I shows the enol-form and II the keto-form of diketopiperazine. The presence of an O—H linkage, required by the former structure, would give a band in the region 2·87–2·97 μ, and =CH vibrations at 3·20–3·30 μ should also appear. (If the O—H group were linked to a C—C instead of a C=C valence, as has been suggested, a band at 3·03 μ would appear instead of that at 2·87–2·97 μ.) With the carefully dried specimen, however, no trace could be found of either the =CH vibrations or of a band at 3·03 μ, so that the bands at 2·928–2·953 μ cannot be ascribed to an O—H vibration associated with the enol-form. They are accordingly assigned to the first overtone of the C=O group, which is consistent with the keto-form of the compound. Additional evidence for this form is the presence of –CH bands between 3·4 μ and 3·6 μ, which shows that the diketopiperazine molecule cannot possess any double bonds between carbon atoms. Furthermore, the similarity of the spectrum of the tetramethyl derivative (where no possibility of a keto-enol tautomerism exists) with the spectrum of diketopiperazine confirms the conclusion that in the crystalline state the diketopiperazine occurs in the keto-form (II), free from mixture with the enol-form. It should be remarked, however, that the observations do not preclude the possibility that a certain amount of each substance exists in the lactim-form, in which the hydrogen is linked with the C=O groups instead of with the nitrogen atoms. The result of this transformation is a double bond between the nitrogen atoms and the carbon of the C(OH) groups. It is clear, however, from the occurrence of the NH bands, that the diketopiperazine and the tetramethyl derivative cannot be wholly in this form. A full account of the experiments and a detailed interpretation of the observed bands will be published elsewhere.

I am very much indebted to Prof. A. C. Chibnall and Dr. W. T. Astbury for providing me with the diketopiperazine and the tetramethyldiketopiperazine.

LOTTE KELLNER.

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June 22.

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[1] Sanborn, *J. phys. Chem.*, **36**, 1799 (1932).

Radioactive Isotopes of Element 43

PROF. E. O. LAWRENCE, of the University of California, gave us a plate of molybdenum which had been irradiated with deuterons in the Berkeley cyclotron. The plate showed a strong radioactivity due to more than one body. The half-value periods are of the order of magnitude of some months. A chemical investigation of the activity ruled out any radioactive isotopes of zirconium, niobium, molybdenum or ruthenium, and shows most probably that the activity is due to isotopes of atomic number 43 (masurium of I. and W. Noddack).

Since the chemical properties of this element are practically unknown, we investigated the activity in order to collect some information on the chemistry of 43. This element bears the closest resemblance to rhenium, and shows the same reactions as rhenium with sulphuretted hydrogen, nitron, etc., but it can be separated from rhenium by the method used by Geilmann and Weibke[1] for the separation of molybdenum and rhenium.

We wish to express our thanks to the Radiation Laboratory of the University of California for the gift of molybdenum. A more detailed account will be published in the *Rend. Lincei*.

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June 13.

[1] Gellmann and Weibke, *Z. anorg. allgem. Chemie*, **199**, 120 (1931).

Optical Rotatory Power of Turbid Solutions in an Electric Field

IN a previous note in this journal[1], A. McLean and I published the results of some experiments on the rotation of the plane of polarization of organic compounds dissolved in various solvents under the action of an electric field. These measurements were continued, and the results published in the *Philosophical Magazine*[2] by J. Kunz and P. H. Babcock.

For some solutions the results could be repeated, but for other solutions the curves obtained were very complicated and could not be repeated, so that the explanation of the phenomenon given became doubtful. These measurements were continued, and we found that the solution of methylester in benzene showed a slight turbidity, due probably to a suspension of naphthalic anhydride; indeed the carefully filtered solution gave no effect, even under the action of alternating fields so high as 15,000 volts per centimetre. Therefore, either some type of compensation is present in this particular solution (such as opposite effects on solvent and ester), or the magnitude of rotation does not depend so much upon the electrical structure as was first assumed. As in the present experiment, the expected effect was not observed, the dipole induced in the given fields may be too small.

When it was found that the rotation was due to a suspension, experiments were carried out using finely grounded calcite, quartz, iron oxide (Fe_2O_3), china clay, sodium chloride, etc., all of which gave an effect. The calcite suspension in benzene was one of particular interest, since it gave rotations from zero to 15°; in some cases a maximum rotation of 5° was observed at about 3,000 volts per centimetre; then the rotation decreased with increasing fields, reached a minimum and began to increase again. When the field decreased, the curve was either above or below the branch obtained by increasing fields. These features depended upon the platinum electrodes in the polarimeter tube, which were too flexible and were moved upon application of the higher voltages. The difference in the two paths is due to settling or to mixing. The tube was reconstructed by supporting the electrodes in three places, and then the rotation reached a constant value at comparatively low fields.

The optical activity of suspensions is well known; it has received much attention by French and German physicists and chemists[3].

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June 5.

[1] NATURE, **136**, 795 (1935).
[2] *Phil. Mag.*, (7), **22**, 616 (October 1936).
[3] See, for example, Stefan Procopiu, *Ann. Phys.*, **1**, 213 (1924).

WE have been investigating the effect described by Prof. Kunz and R. G. LaBaw, first in conjunction with McLean, who, however, had to leave it to take up other work. Although the solutions were apparently quite clear and free from obvious particles, we were led to suspect in some cases that the result might be due to very minute crystals in suspension in the liquid; we have also heard from Prof. Kunz that he has come to the same conclusion. Very careful filtration through selected filter papers removes the optical activity. The conclusion is, then, that the effect is due to dichroism induced in the particles by the electric field, a phenomenon not entirely new, although its accurate quantitative investigation is beset by numerous difficulties.

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Air-drag and the Equilibrium of Whirling Threads

IN the absence of all resistance to motion and assuming perfect flexibility, the differential equations of motion for a thread which carries a small spherical 'bob' and is whirled rapidly about a vertical axis by a horizontal arm give us an approximate solution for small amplitudes a plane sine wave—with reference to moving axes—leading to the well-known formula for plane vibrations[1]. This approximate solution throws no light whatever on the stability of whirling threads as observed experimentally in air: these threads show 'necks' of appreciable amplitude in place of point nodes, the necks increasing in diameter the farther they are from the 'bob'. With sufficiently long threads and a large radius of the whirling arm, the sine outline disappears altogether.

I have recently found that if a term be introduced for air-drag—assumed proportional to the square of the linear velocity—the differential equations then admit of an approximate solution which not only gives the outline of the thread with surprising accuracy but also fully explains the limited stability of the system as described by Hall (*loc. cit.*).

For ease in experimental interpretation, the solution is best referred to moving rectangular axes, the vertical axis of whirl being the Z-axis. The form of solution is then:

$$x = R(1+\tfrac{1}{6}\mu^2z^3+\tfrac{1}{18}\mu^4z^6\ \ldots)\sin\beta z,$$
$$y = R\mu z(1+\tfrac{1}{6}\mu^2z^3+\tfrac{2}{63}\mu^4z^6\ \ldots)\quad\cos\beta(1+\tfrac{1}{4}R^2\beta^2)z;$$

where z is measured from the node of the lowest balloon, R is, effectively, the radius of the lowest balloon, determined by the radius of the whirling arm; β^2 is $m\omega^2/Mg$; m is thread mass per centimetre; ω is angular velocity of whirl; M is mass of 'bob'; g is gravitational constant; μ is $(\gamma/2\beta)(1-\tfrac{1}{4}R^2\beta^2)R$; γ is $P\omega^2/Mg$; P is coefficient of air-drag per centimetre of vertical thread.

This solution gives the projection of the spiral thread on two perpendicular vertical planes. The x-values are conveniently referred to as the 'centrifugal wave', the y-values as the 'drag wave'. The period of the drag wave differs from that of the centrifugal wave by the small factor $\tfrac{1}{4}R^2\beta^2$, so that the positions of minimum amplitude do not coincide exactly with the nodes of the centrifugal wave. This point is clearly shown in photograph *b* of Hall's note (*loc. cit.*). The accuracy of this solution appears to depend primarily on the magnitude of the expansion coefficient μ and is good, within this limitation, for very large values of the balloon amplitude: we are no longer tied to infinitely small amplitudes.

The value of μ is commonly so small that, with appropriate corrections which will be self-evident from the equations, if r is the radius of the first 'neck' and R is the radius of the first balloon, then

$$\frac{P}{m} = \frac{2r}{\pi R^2}$$

Measurements of this 'drag ratio' are now in progress, using a coincidence method involving a specially constructed prismatic instrument which eliminates the slight sway inseparable from these whirling systems.

Very fine threads are found to give larger values of the drag ratio than coarse ones in approximately the ratio of their diameters, as might be expected. There appears to be a slight decrease in the drag coefficient with increased whirling speed, which is possibly due to increased air swirl in the system or a departure from the square law.

I hope shortly to give elsewhere a full account of these measurements and the derivation of these equations.

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[1] Hall, H. W., NATURE, 138, 932 (Nov. 28, 1936).

Maintenance of the Pulsation in Cepheid Variables

THE oscillations induced in the principal modes of vibration of a star by a free oscillation in one of them, generally of the second order in the corresponding free amplitude, are unimportant unless magnified by resonance; so seems the evidence from Miss H. A. Kluyver's analysis[1]. Hence, the motion in a Cepheid variable may be closely approximated to by the superposition of the oscillations of two modes of vibration, a free one and a forced one with half the period.

The damping constant of this composite motion is a weighted mean of the constants referring to the components, the weight factors being proportional to the energies of the separate oscillations. As, excepting exact commensurability, the ratio of these weight-factors is proportional to the square of the free amplitude, the dissipation of the energy of the pulsation depends on this amplitude.

As regards the damping constants of the components of the motion, it is to be remarked that each is the sum of positive and negative terms; the positive terms result from the dissipation of energy in the outer part of the star, hence probably are much larger for the mode of vibration corresponding to the forced oscillation; the negative terms, resulting from the generation of energy, probably are of the same order of magnitude in both cases. Hence the possibility arises that the damping constant belonging to the free oscillation is negative and that belonging to the mode of vibration in forced oscillation is positive.

If the damping constants in actual stellar conditions have values corresponding to the possibility referred to, then the star may adjust its amplitude in such a way that the damping constant of the composite motion is zero: the pulsation may be maintained indefinitely. If a state of affairs is assumed in which the amplitude is very small, then the negative dissipation of energy of the free oscillation intensifies the motion, until the positive dissipation corresponding to the induced vibration restores the balance: a permanent state of pulsation has been reached.

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[1] *Bulletin of the Astronomical Institute of the Netherlands*, 276.

Photo-decomposition of Aldehydes and Ketones

ALDEHYDES and ketones decompose in the gas phase in two main ways[1]. Type I, predominant with short chain compounds, may be represented $RCOR' \rightarrow CO + (RR + RR' + R'R')$. Type II, predominant with long-chain compounds, involves a cracking of the long hydrocarbon chain in a position $\alpha - \beta$ to the carbonyl group, giving a lower carbonyl compound and an olefine.

We recently described[2] certain results obtained in a study of the photo-decompositions of such compounds in paraffinoid solution, in which circumstances both types of decomposition were found to occur, type I being subject to a marked temperature coefficient while type II is not.

These results have now been extended to other carbonyl compounds, and appear to be of general significance. Thus methyl ethyl and diethyl ketones in 10 per cent liquid paraffin solution show no appreciable photolysis at 20° C., but ready decomposition according to type I at 100°.

The products arising from the type I photolysis in all ketones studied in paraffinoid solution are modified in a very simple but profound way, for whereas in the gas phase a mixture of the three hydrocarbons RR, RR′ and R′R′ together with an approximately equivalent volume of carbon monoxide is obtained, in solution the hydrocarbon products occupy more than double the volume of the carbon monoxide and consist only of the hydrogenated products of the alkyl radicals, RH and R′H. None of the RR′ and R′R′ hydrocarbons, previously found in the gas phase can be detected. It is clear that the free radicals disengaged in the photolysis must mainly react with the molecules of the paraffin solvent rather than combine together, as they do in the vapour. That this is substantially true is shown by the fact that an unsaturation develops in the paraffin solvent which, on removal of the carbonyl compound by distillation *in vacuo*, can be titrated with bromine water, and is equivalent in amount to the unsaturation which would be expected from the volume of the products. This suggests a continuous interchange of hydrogen atoms between paraffinoid free radicals and paraffin molecules, until two such free radicals meeting react to give an olefine and a paraffin by disproportionation.

With methyl ethyl ketone, the ethane produced is in excess of the methane, and this and a deficiency of carbon monoxide with reference to the total hydrocarbon produced has been correlated with the presence of acetaldehyde which we were able to estimate. These results suggest that the reaction

$$CH_3CO + C_nH_{2n+2} \rightarrow CH_3CHO + C_nH_{2n+1}$$

can occur in paraffinoid solution.

Aldehydes differ from ketones in that photodecomposition according to type I occurs in solution at room temperatures, and further in that the gaseous products are for the most part the same as those in the gas phase. Thus in the case of acetaldehyde the main products are methane and carbon monoxide, with a slight excess of the former. Butaldehyde and isovaleraldehyde behave similarly giving practically equal volumes of carbon monoxide and saturated hydrocarbon. Both compounds decompose simultaneously according to types I and II, the proportion of each type being approximately the same as in the gas phase, and unchanged in the liquid between 20° and − 80° C.

Since with aldehydes less than 2 per cent of hydrogen is found, and but little unsaturation is developed in the solvent, the mode of type I decomposition is strikingly differentiated from that of the ketones. Thus independent evidence is furnished for the conclusion at which we have already arrived[3], that the hydrocarbon is produced from aldehydes mainly in one act, namely, RCHO → RH + CO, whereas in ketones free radicals are first formed. This conclusion can also be shown to be in accord with the fact that, with ketones in solution, the type I decomposition is subject to a marked temperature coefficient, while with aldehydes it is not.

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July 13.

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[1] Norrish and Appleyard, *J. Chem. Soc.*, 874 (1934). Bamford and Norrish, *J. Chem. Soc.*, 1504 (1935).

[2] Norrish and Bamford, NATURE, **138**, 1016 (1936).

[3] Norrish and Kirkbride, *J. Chem. Soc.*, 1518 (1932). Norrish, *Trans. Farad. Soc.*, **30**, 107 (1934); *Acta Physica Chemica URSS*, **3**, 171 (1935).

Elementary Cell and Space Group of Ethyl-chlorophyllide

CHLOROPHYLL itself prepared after Stoll[1] is amorphous, giving in X-ray photographs only one broad ring corresponding to a distance of 4·2 A. However, by replacing the phytol group by the ethyl group, a crystallizable compound can be obtained. Ethylchlorophyllide was prepared from leaves of *Heracleum*, following also the method of Stoll. By evaporation from etherical solutions small crystals, weighing about 2 γ, were obtained in the form of thin equilateral triangles. The crystal form was, as already remarked by Willstätter and Stoll[1], clearly trigonal hemiedric (symmetry class C_3).

X-ray diagrams with copper *K* α-rays were obtained by oscillation through various angles about the *a*-axis $[10\bar{1}0]$ and about $[11\bar{2}0]$, the *a*-axis being parallel to the side of the triangle.

The dimensions of the elementary cell are: $a = 8·90 \pm 0·02$ A.; $c = 38·4 \pm 0·2$ A. For the density, the value 1·11 as found for chlorophyll was taken. The number of molecules of $C_{32}H_{30}ON_4Mg.CO_2CH_3.CO_2C_2H_5.H_2O$ (the crystals were most probably those of the *a*-component) contained in the cell was thus found to be 2·7 or approximately 3; so the exact value of the density is 1·24.

The X-ray diagrams confirmed the presence of a threefold axis, with no symmetry plane through the *c*-axis or at right angles to this axis. So only the *symmetry classes* C_3 *and* C_{3i} *are possible, the latter* being improbable from the external form of the crystals. As only those reflections 000*l* for which $l = 3n$ *are found and, further, many of the reflections* are inconsistent with a rhombohedral lattice, the space group will be one of the pair of enantiomorphic groups C_3^2 and C_3^3. In *these space groups the centres* of the molecules, that is, the magnesium atoms, will be arranged in spirals around the *c*-axis.

A discussion of the observed intensities in relation to the shape of the molecules will be given later. We intend to investigate also the compounds derived from ethyl-chlorophyllide by replacing the magnesium atom by other bivalent metals such as copper and zinc.

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[1] Willstätter, R., and Stoll, A., "Untersuchungen über Chlorophyll" (Berlin, 1913).

Œstrous Reactions, including Mating, Produced by Triphenyl Ethylene

DODDS and his co-workers have described a number of synthetic substances with œstrogenic activity.

We have found that 1·0 mgm. of triphenyl ethylene[1], dissolved in oil, produced full vaginal cornification when injected into ovariectomized mice. A dose of 10 mgm. injected in two doses on two successive days produced cornification lasting for some eight to nine weeks, and partial cornification was present for a further period. The injections also caused œstrous distention of the uterus. Ten ovariectomized mice injected with 10 mgm. of the substance were placed with potent males and five of these have mated, as judged by the finding of vaginal plugs; one of these animals mated twice, namely, 5 and 15 days after the injections.

Œstrous changes in the uterus and in the vulva and also mating have been induced in each of two hypophysectomized rabbits.

Although the œstrogenic activity of triphenyl ethylene, as estimated by vaginal cornification, is only about 1/10,000 that of œstrone, yet it can produce effects of remarkable duration, and its power to produce mating is also noteworthy.

The minimum amount of the substance necessary to produce vaginal cornification when given by mouth in solution of oil is approximately the same as when given subcutaneously. Larger doses given by mouth produce cornification lasting for about a week.

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[1] Klages and Heilmann, *Ber. deutsch. chem. Ges.*, **37**, 1455 (1904).

Carotenoids of the Chicken Retina

THE cones of many bird and reptile retinas contain brilliantly coloured oil globules. In the chicken they are red, golden and yellow-green[1,2]. They possess considerable interest, for light must filter through them to enter the sensitive cone outer limbs, and they may serve, therefore, as a mechanism for colour vision[3].

Kühne and Ayres[2] effected a crude separation of chicken retinal pigments into three fractions: purplish red "rhodophane", golden or orange "xanthophane", and yellow-green "chlorophane".

We have crystallized three such pigments from retinal extracts. They are carotenoids, and in suitable solvents reproduce closely the colours of the retinal droplets:

(1) The purplish red pigment, astacene. Epiphasic when shaken with benzine and 90 per cent methanol. Soluble in concentrated caustic potash; precipitates as a red soap on dilution with water. Crystallizes from methanol-acetic acid in thin, curved, purple blades; from pyridine in fine needles. Crystals insoluble in benzine, almost insoluble in methanol, readily soluble in pyridine. The spectrum consists of a single broad band, maximal at 477 mμ in hexane (Fig. 1 *a*), at 499·5 mμ in pyridine, at 497 mμ in castor oil (used to simulate the retinal oil).

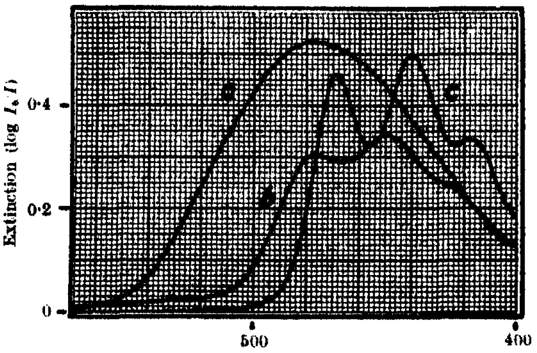

Fig. 1.

(2) A golden or orange xanthophyll. Shaken with benzine and 90 per cent methanol, it is epiphasic before and hypophasic after saponification. This is the typical behaviour of xanthophyll esters. Crystals from methanol solution are orange-red in colour, practically insoluble in benzine, readily soluble in methanol. The spectrum possesses three bands, at (421), 449·5 and 478 mμ in hexane (Fig. 1 *b*), and at (430), 463 and 490 mμ in castor oil. This is close to the spectrum of lutein (447·5 and 477·5 mμ in benzine).

(3) A yellow or yellow-green hydrocarbon. Epiphasic when shaken with benzine and 90–95 per cent methanol. Crystals from methanol solution are russet in colour, almost completely insoluble in methanol, readily soluble in hexane. The spectrum possesses three sharp maxima, at 418, 440 and 469·5 mμ in hexane (Fig. 1 *c*), and at 428, 450 and 480·5 mμ in castor oil. This spectrum lies at much lower wave-lengths than that of any known carotene except sarcinene (415, 440, 469 mμ)[4].

It seems clear from the appearance of the cone globules that one of these pigments predominates in each of them. The fact that one pigment is acidic, one an alcohol and one a hydrocarbon greatly aids their separation *in vitro*. A precisely similar situation is found in the retina of the turtle, *Clemmys insculpta*[5]. Possibly this chemical differentiation is the basis also of pigment segregation *in vivo*.

Astacene apparently is synthesized by the chicken. We found no trace of it in chicken livers or serum. Though none could be found in the egg yolk, red cone droplets appeared in our chick embryos on the nineteenth day of incubation (37° C.). The hydrocarbon pigment also may be synthesized *in situ*, for it has not been identified either in the egg or in the customary chicken diet.

If the chicken depends upon these pigments for colour discrimination, it should fail to differentiate monochromatic lights between about 600 mμ and 700 mμ, for none of the pigments in castor oil absorbs appreciably in this region. It is significant that the pigeon, which possesses a similar system of cone droplets, is unable to discriminate hue differences between 615 and 700 mμ[6].

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June 25.

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[1] Hannover, A., *Arch. Anat.*, 314 (1843); colour plate in Hess, C., "Hdbch. vergl. Physiol.", **4**, 555 (1913).

[2] Kühne, W., and Ayres, W. C., *Unters. physiol. Inst. Heidelberg*, **1**, 341 (1878); *J. Physiol.*, **1**, 109 (1878–79).

[3] Schultze, M., *Arch. mikr. Anat.*, **2**, 175 (1866); Roaf, H. E., *Physiol. Rev.*, **13**, 43 (1933).

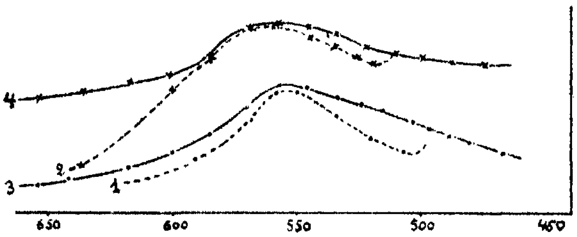
[4] Chargaff, E., *Naturwiss.*, **20**, 872 (1932).

[5] Wald, G., unpublished observations.

[6] Hamilton, W. F., and Coleman, T. B., *J. Comp. Psych.*, **15**, 183 (1933).

Position of Maximum Optical Sensitivity of Sensitized Photographic Plates

IN one of the first papers[1] on the phenomenon of sensitization of photographic plates to the long-wave rays of the spectrum by dyestuffs, Vogel noted that the maximum sensitivity is often shifted by several hundred Angstrom units towards the red in comparison with the maximum absorption of the dyestuffs in solution. The usually accepted explanation[2] of this phenomenon is that it is due to the displacement of the maximum of absorption of the dyestuff by its adsorption on the silver halide. But on account of the difficulties connected with measuring the absorption by scattering media, this hypothesis has not yet been confirmed experimentally.



POSITIONS OF MAXIMA OPTICAL SENSITIVITY
Fig. 1.

With the aid of the König-Martens spectrophotometer, we have obtained absorption curves of erythrosin and phloxine sensitizers adsorbed on transparent layers of silver bromide sublimated in vacuum. They were prepared by a method analogous to the method of de Boer[3] as described in a series of papers by him on the adsorption of dyestuffs on sublimated layers of alkali earth metals.

In Fig. 1, Curves 1 and 2 represent the curves of the spectral sensitivity of plates sensitized with erythrosin and phloxine, reduced to the same number of incident quanta. Curves 3 and 4 represent the curves of absorption of these dyestuffs adsorbed on layers of silver bromide.

As it is to be seen from the figure, the wave-length of the maxima of sensitivity coincides exactly with the wave-length of the maxima of absorption of adsorbed dyestuffs (erythrosin, 558 mμ; phloxine, 563 mμ) whereas the maxima of absorption of the dyestuffs in solution lie at 523 mμ for erythrosin and at 524 mμ for phloxine.

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[1] Vogel, H., *Ber. deut. chem. Ges.*, 7, 976 (1874).

[2] Bonhoeffer, K., and Harteck, P., "Grundlagen der Photochemie" (Dresden und Leipzig: Th. Steinkopff, 1933), p. 278.

[3] de Boer, J. H., *Z. physik. Chem.*, B, 15, 281 (1932).

Glyceraldehyde and Embryonic Glucolysis

It has already been reported[1,2] that anaerobic lactic acid production from glucose in the chick embryo is a true case of non-phosphorylating glucolysis, strongly inhibited by *dl*-glyceraldehyde. As possible intermediates, glycerol, glyceric acid, dihydroxyacetone and methylglyoxal were excluded. We are now able to add to the list pyruvic acid and glyceraldehyde.* Of the two stereoisomers, *only* *l*-glyceraldehyde inhibits glucolysis; this corresponds in its configuration to *l*-lactic acid (sarcolactic acid) which derives from glucose in the body. The inhibitory effect is complete at a concentration of about $2{\cdot}5 \times 10^{-3}\ M$. The fact that *dl*-glyceraldehyde does not apparently inhibit glucolysis more than about 90 per cent is due to a slow enzymic lactic acid formation from glyceraldehyde itself. This process needs glutathione as co-enzyme and is not based upon a primary condensation of trioses to hexose, as it is not inhibited by amounts of fluoride or iodoacetate which would be enough to poison a secondary glucose breakdown. It is due rather to the non-enzymic formation of methylglyoxal under the experimental conditions, which is then converted to lactic acid by the glyoxalase present.

The exclusion of so many 3-carbon compounds as possible intermediates of glucolysis proper induces us to refer to the work of Nef[3], who showed an *in vitro* intramolecular shifting of the enol linkage along the carbon chain in hexoses, and suggested a similar process for the enzymic breakdown of glucose. Such a shifting of enol linkages would make it possible to understand how *l*-lactic acid can derive from *d*-glucose *in vivo*. The final step would be an intramolecular dismutation. The occurrence of enolization and dismutation would explain the inhibition of glucolysis proper by fluoride and iodoacetate, which also poison (though in different concentrations) the enolase and dismutase of hexosediphosphate breakdown.

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* We are greatly indebted to Prof. H. O. L. Fischer and Dr. Baer of Basel, for a gift of *d*-glyceraldehyde.

[1] Needham, Nowinski, Cook and Dixon, NATURE, 138, 462 (1936).

[2] Needham and Lehmann, NATURE, 139, 368 (1937).

[3] Nef, *Liebigs Annalen*, 376, 1 (1910).

Technique of the Painting Process in the Temple of Vijayalaya Cholisvaram in Pudukottah State

THE ruined temple of Vijayalaya Cholisvaram is situated in the village of Narthamalai (10° 30′ N., 78° 45′ E.) in Pudukottah State in South India, being about five miles to the north-east of Sittannavasal[1] and about 33 miles, as the crow flies, from Tanjore[2]. The temple was probably built in the ninth century A.D. during the time of Vijayalaya, a king of the Chola Dynasty of South India. The details of the paintings, however, have either faded or disappeared, due to the vicissitudes of time and environment, so that it is very difficult to judge of the art as such. But circumstantial evidences go to show that the paintings were probably executed during the eleventh–twelfth centuries A.D., and at any rate, their date cannot be later than the fourteenth century A.D. If they belong to the eleventh–twelfth centuries A.D., they should have been contemporaneous with the Chola paintings in the Brihadisvara temple[2] at Tanjore.

The paintings are executed on the inner walls of the front hall of the temple, which are constructed of large blocks of hornblende-gneiss. The technique adopted is a combination of tempera with fresco. The painted stucco consists of the *Rinzaffo* or the rough coat of lime plaster with a fine lime wash thereon, the latter having been applied while the plaster was still wet. Over this is a layer of paint of appreciable thickness. The thicknesses of the different layers are: painted stucco, 3·3 mm.; rough plaster, 2·3 mm.; lime-wash, 0·4 mm.; paint film, 0·6 mm.

The results of analysis of the rough plaster and the paint film (red paint film being chosen for the purpose) are given in the accompanying table.

	Rough plaster (per cent)	Red paint film (per cent)
Moisture	1·39	1·71
Carbon dioxide	20·95	11·67
Loss on ignition	4·29	11·86
Silica (SiO_2)	37·83	38·85
Iron and alumina (Fe_2O_3, Al_2O_3)	1·79	7·63*
Lime (CaO)	31·73	25·09
Sulphuric anhydride (SO_3)	0·03	0·27
Magnesia (MgO)	0·66	1·68
Undetermined (mostly alkalis)	1·38	1·24
	100·00	100·00

* Al_2O_3 being only 0·73 per cent.

The high value of the loss on ignition of the paint film, amounting to 11·86 per cent, is significant, and goes to show the presence of organic matter in the paint film used as a binding medium.

The only inert material used with the lime is sand.

So far as the pigments are concerned, lime has been used for the white, carbon for black, yellow and red ochres for yellow and red and terre verte for green. There are traces of a light, bluish-green colour, but sufficient quantity of it is not available for identifying the blue pigment.

Full details of the investigation will be published elsewhere.

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July 5.

[1] NATURE, 139, 114 (1937).

[2] NATURE, 137, 867 (1936). *Technical Studies* (Harvard University), 5, 221–240.

Neural Induction by Plant Tissues in the Ectoderm of the Gastrula of *Triton taeniatus*

To investigate the problem concerning the inductive action of plant tissues in the ectoderm of the gastrula, plant tissues rich in nuclear and plasmatic content were used, such as meristem, cambium, ovaries and anthers. Fragments of these tissue, living or dead, were implanted into the blastocœle of an early gastrula of *Triton*.

Four series of experiments were carried out. In the first series, fragments of oat root meristem were inserted either in the fresh condition or after subjection to short boiling in water. Thickenings were formed in the ectoderm at the points in contact with the implant. In the second series, pieces of growing points of potato shoots were used, fresh or boiled. A greater proliferation of the ectodermal cells in the region of contact took place. In the third series, fresh cambium of the birch tree was grated and introduced immediately into the blastocœle of a growing gastrula. Clear instances of inductions of neural plate were obtained, the superficial and deep layers showing a definite differential effect. As might be expected, the cambial layer was the most effective. The reason for this may be that the more tender membranes of the cambium are more easily destroyed by grating. The fourth series forms the control, and shows that the cell membrane is an insurmountable obstacle for inducing substances. Plant subjects such as anthers or whole stamens were implanted with unimpaired cell membranes. In these cases no induction was obtained.

Our results contradict those of Holtfreter's work on plant material (1934, p. 348)[1], but they suggest an explanation of the negative results of his experiments. Holtfreter used plant objects containing much nutritive material (pieces of banana, dough of wheat flour, potato starch).

The unity of plant and animal tissues thus shown may find corroboration in the biochemical field. Butenandt and Jacobi (1933)[2] extracted folliculin from palm seeds. This folliculin was identical with the folliculin $C_{18}H_{22}O_2$. Skarżynski (1933)[3] obtained a hydrate of follicular hormone from flowers, whereas up to that time this substance had only been obtained from the urine of pregnant women and from the placenta.

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[1] Holtfreter, J., *Archiv f. Entwicklungsmech.*, **132**, 225 and 302 (1934).

[2] Butenandt, H., and Jacobi, H., *Z. physiol. Chem.*, **218**, 104 (1933).

[3] Skarżynski, B., NATURE, **131**, 766 (1933).

Neural Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the Ectoderm of the Anuran Gastrula

IN the springs of 1934 and 1935, experiments were made on the influence of pieces of dead tissue (killed by means of desiccation, boiling and treatment with alcohol) on the ectoderm of the gastrula of Anura, and tests were carried out in which parts of organs of tadpoles and adult Mammalia were implanted into the blastocœle cavity of the gastrula.

Embryos of *Bufo viridis* proved to be the best test material, but eggs of *Rana esculenta* were also used. All tests gave positive results. Pieces of the upper lip of the blastopore were desiccated at 60°, others were boiled in water. Some were fixed in 95 per cent alcohol, and later resoftened.

Fragments of muscle, brain and liver were the most effective of all the organs of anuran tadpoles. Fragments of mammalian organs, especially of liver and of kidneys, showed the highest inductive capacity. Our results confirm the work of Holtfreter (1934)[1], who has shown that mammalian tissues are the most effective in inducing axial organs, and add weight to the view that neural induction is chemical in nature.

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[1] Holtfreter, J., *Archiv Entwicklungsmech.*, **132**, 225 and 302 (1934).

Distribution of the Biting-louse

THE biting-louse, *Heterodoxus longitarsus* (Piaget), is primarily a parasite of certain didelphian mammals (Macropodidæ), but it has been found also upon non-didelphian hosts. It has been recorded from domestic dogs, a jackal, a coyote, *Oncifelis salinarum*, and a man; also from the passerine bird *Corone australis*. We have examined the original specimens of most of these records and, in addition, have a number of new records from the dog.

This straggling is of interest from two points of view. First, the parasite has become established upon one of these non-didelphian hosts, the domestic dog, and is even the usual dog louse in some localities. Secondly, on this host it appears to have a geographical and local distribution. Of the conditions necessary for the establishment of a louse species on a host other than its 'phylogenetic' host nothing is known; but with the apparent opportunities for transference it is amazing that it has not occurred more often. The earliest date recorded for the occurrence of the parasite on a non-didelphian host is 1902, in Africa.

On examining the locality records, there seems to be a definite geographical distribution such that it occurs only in temperate and tropical areas, roughly confined between lat. 40° N. and lat. 40° S. Thus, we are informed that the parasite is not known from the U.S.S.R., or from Canada; and it does not appear to occur in Europe. The information, from the literature in our records, indicates that within the two parallels of latitude the distribution is localized.

We are indebted to a great number of workers for our data. Accounts of the distribution and of the diagnostic anatomy of the parasite are in preparation.

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University of Cambridge.

GORDON B. THOMPSON.

British Museum (Natural History),
London, S.W.7.
July 2.

"The Handbook of British Birds"

As many ornithologists are already aware, a new edition of "A Practical Handbook of British Birds" has been for some time in preparation. We should be very grateful to any of your readers who would now send us notes of any omissions or errors in the original work, and of any *unpublished* observations which would make the work more accurate and complete. Should secrecy in regard to locality be necessary, this will be rigidly respected.

Since the "Handbook" was completed twelve years ago, such a vast amount of matter relating to distribution, migration, breeding-habits and food has been published, both at home and abroad, that the revision made necessary is a very heavy task involving the rewriting of most of these sections.

Moreover, field characters, habitat, song and 'habits' generally, to which very little space was devoted in the original work, will be greatly expanded, and these new sections are being undertaken by Mr. B. W. Tucker (with Mr. Charles Oldham's kind approbation).

The new work will be very fully illustrated in colour, the aim being to show all the birds in so far as possible all their plumages. Such a series of illustrations is not now available to British ornithologists, and it is hoped that this new feature will greatly enhance the usefulness of the work, especially to observers in the field.

The original "Practical Handbook" will be in fact so much a new work that we consider an alteration of the title to "The Handbook of British Birds" justified.

As it is proposed to publish in five volumes at six-monthly intervals, beginning next spring, we shall be glad to have now any notes relating to the order Passeres. It would be a convenience if observations concerning breeding habits or food were sent direct to the Rev. F. C. R. Jourdain at Bellevue Road, Southbourne, and all other notes to me at Gracious Pond Farm, Chobham, Surrey.

H. F. WITHERBY.

July 21.

Points from Foregoing Letters

THREE new types of pleochroic haloes have been found by Prof. G. H. Henderson in the course of an extended examination of biotite specimens. Apparently these are due to certain elements of the uranium family, and are of hydrothermal origin.

A table comparing the ability of colchicine to reduce the size of plant tumours (induced in tomato plants by *B. tumefaciens*) with the effect produced by palmitic acid, by removing the flowers, or covering the terminal buds, is given by L. Havas. The author infers that colchicine, like the other factors mentioned, inhibits the growth through the intervention of plant hormones.

Dr. N. Kemmer gives a condition that must be satisfied by nuclear force-constants in order to account for the fact that nuclei with very large spin do not exist. The force constants previously derived by Volz must be altered to fulfil this condition.

Dr. Lotte Kellner concludes, from infra-red absorption spectrum observations, that in the dry crystalline state the molecules of diketopiperazine and tetramethyldiketopiperazine exist in the keto-form free from mixture with the enol-form.

A radioactive element formed in molybdenum irradiated with deuterons has been investigated by C. Perrier and Prof. E. Segrè. They attribute the radioactivity to isotopes of atomic number 43 (masurium), and find that their reactions are similar to those of the element rhenium.

Further experiments by Dr. J. Kunz and others show that the rotation of the plane of polarization attributed by J. Kunz and P. H. Babcock to organic compounds dissolved in various solvents, under the influence of an electric field, is in reality due to the dichroism induced in suspended particles by the electric field, a phenomenon already known.

An approximate solution of the differential equations of motion of loaded, flexible threads whirling about a vertical axis and subject to air-drag has been developed by E. R. Goshawk. The solution accounts for the limited stability of such systems and is not materially affected by the amplitude of whirl. A simple method is indicated for measuring the air resistance to the motion of cylindrical threads —rough or smooth—at high whirling speeds.

Dr. J. Woltjer, jun., points out the possibility of the existence of a self-regulating mechanism which would maintain the pulsation of a star, depending on the superposition of the oscillations of two modes of vibration, a free and a forced one.

Two types of decomposition of the methyl-ethyl and diethyl ketones in 10 per cent liquid paraffin solution, are described by Prof. R. G. W. Norrish and C. H. Bamford. They find that solvent molecules react with the radicals liberated by the photolysis.

An X-ray investigation by Dr. J. A. A. Ketelaar and E. A. Hanson of the ethyl derivative of chlorophyll, said to be the first of the chlorophyll derivatives to be examined by the X-rays, indicates that the molecules are arranged in spirals.

Three crystalline pigments belonging to the group of carotenoids have been obtained by Dr. G. Wald and H. Zussman from extracts of chicken retinas. One is purplish red (astacene), another a golden or orange xanthophyll, and the third a yellow or yellow-green hydrocarbon. None of these absorbs light in the region 600–700 mμ, and the authors suggest that the chicken, like the pigeon, may be unable to discriminate hue differences in this region.

Curves showing that the maximum sensitivity of photographic plates sensitized with dye-stuffs (erythrosin and phloxine) corresponds with maximum absorption by those dyes when absorbed on layers of silver bromide (but not with their maximum absorption when *in solution*) are submitted by S. Natanson.

Dr. J. Needham and H. Lehmann have investigated the inhibition of embryonic glucolysis by glyceraldehyde—it is due only to *l*-glyceraldehyde. The fact that the inhibition is apparently incomplete is due to lactic acid formation from glyceraldehyde itself. This is brought about by its transformation into methylglyoxal, which is then converted to lactic acid by glyoxalase.

S. Paramasivan reports that the paintings in the temple of Vijayalaya Cholisvaram at Narthamalai in Pudukottah State (South India) have been executed in a technique which is a combination of fresco with tempera. Lime, carbon, yellow and red ochres, and terre verte have been used as pigments.

Research Items

The Quinault Indians, Washington, U.S.A.

THE Indians who speak a Salish dialect lived in a region of the State of Washington, of which the Quinault River, with its valley, was the heart. In addition to the region drained by the river, they also occupied a district along the beach between a point near the mouth of the Raft River and a spot near the present site of the village of Pacific Beach, or the mouth of Joe Creek. In practice, their boundaries were not strictly defined, and the feeling of ownership or exclusive right to this territory was unheard of. The heights above the source of the river were more or less common hunting ground for several neighbouring tribes. The whole region was covered with a luxuriant growth of vegetation. In 1855, they ceded part of their territory to the Government, and since then have lived in the present Quinault Indian Reservation. Between 1925 and 1927 they were visited on three occasions by Mr. Ronald L. Olson under the auspices of the Department of Anthropology, University of Washington, for the purpose of studying the vanishing relics of their tribal culture, of which there has been no systematic description (*Univ. Washington Pub. in Anthrop.*, 6, 1). "Quinault" is a corruption of "kwi'nail", the name of the largest settlement situated at the site of the present village of Taholah. A list of thirty-eight village settlements which had existed along the course of the river was obtained, while some seventy-seven place-names were collected. An approximate estimate for the population at the beginning of the nineteenth century is eight hundred. Their most important economic activity was the taking of salmon, of which the great run began in March or April. During the run, the men virtually lived at the weir, the fish being passed to the women for dressing and curing. After the run, a variety of activities was open. Some might go to the mountains for hunting elk, bear and deer, others might go to the coast to gather clams, while for every household the winter's supply of bark, grass and roots for baskets and clothing had to be gathered.

Daylight Illumination for Clerical Workers

AN interesting investigation into the problem of the daylight illumination which ought to be provided for clerical workers has been described by L. H. McDermott ("Daylight Illumination Necessary for Clerical Work", Dept. Sci. and Indust. Res., Illumination Res. Tech. Paper No. 19. Pp. iv + 14 + 2 plates. London: H.M. Stationery Office, 1937. 6*d*. net). A mechanical method was devised to ascertain the value of daylight illumination below which workers will make use of artificial light. Briefly, the method employed consisted in photographing a micro-ammeter connected to a photo-electric cell, the motive force for working the camera being derived from the current in the lamp circuit when the subject first switched on the light. The photo-cell was exposed to daylight in a fixed position in one of the office windows, and the reading of the micro-ammeter thus bore a definite relation to the illumination at any particular desk. This relation was determined for each desk occupied by a subject under investigation, and thus it was possible to calculate the daylight illumination at any desk at the moment when the worker made use of the desk light. The results of more than a thousand observations made in a study of seventeen typists are analysed and tabulated. The illuminating value at which the average subject needed artificial light was about 5 foot-candles. Individual subjects varied somewhat in their minimum requirements, but the conclusion that 5 foot-candles is the minimum daylight illumination requirement of the average typist appears to be justified. This result can be applied to determine the average lighting-up time at any season of the year for any given point in a room if the daylight factor for that point is known, and if data concerning the variation of outdoor illumination throughout the day at all times of the year are available. A table is given showing, for positions with various daylight factors, the periods for which natural illumination is sufficient for typists working at desks with specified daylight factors. The figures relate to a non-urban locality in the south of England.

Age and Stock of Blue Whales

THE corpora lutea of whales regress into corpora albicantia, but apparently never become entirely absorbed, so that the ovaries retain a record of the total number of ovulations during the life-history of any female. From material examined in the antarctic, and ovaries extracted and sent to London by whaling factories there, together with date of length, sexual condition, and ankylosis of vertebral epiphyses, Alec H. Laurie has deduced certain important conclusions regarding the antarctic Blue whales (*Discovery Reports*, 15, 223–284, 1937; Camb. Univ. Press, 9*s*. net). The onset of maturity corresponds with the accumulation of eleven corpora lutea in the ovaries, and a minimum body-length of 86 feet, which is attained at ten to eleven years of age. Breeding may take place every two years at best, and a possible average rate of once in two and a half years is suggested. The oldest females taken, probably about thirty years of age, showed no sign of diminishing fertility. The age distribution of the females points to a progressive fall-off in the rate of recruitment of the stock in recent years, so much so that the author considers it now to be insufficient to compensate for the slaughter of modern intensive whaling. Another suspicious fact bearing upon the same point, is the decrease which (contrary to the analysis made by Hjort, Lie and Ruud) is shown in the average length of females captured. From 82·36 feet in 1930–31, the average length has fallen to 78·99 feet in 1935–36, which means that on an average females are killed before they have even begun to reproduce, and in accordance with this the percentage of immature females captured has risen from 15·16 in 1930–31 to 41·67 in 1935–36. These conclusions point to a serious situation. It would appear that the stock of antarctic Blue whales is steadily being encroached upon, since the annual breeding rate is insufficient to cope with the annual destruction (see also p. 180).

A Pest of the Rhododendron

MR. G. FOX WILSON has directed the attention of gardeners to the appearance in Great Britain of a leaf-hopper, *Graphocephala coccinea*, upon the leaves of species of *Rhododendron* and *Kalmia* (*J. Roy. Hort. Soc.*, **62**, Pt. 5, May 1937). The pest normally inhabits the eastern half of the United States. It seems to cause little direct damage to its host, but apparently allows bacteria or fungi to enter the plant tissue, and thus induces secondary infection. Applications of nicotine are recommended where it is necessary to control the activities of the pest.

Chemical Analyses of Rocks and Minerals

BULL. 878 of the Geological Survey of the United States is devoted to a record of analyses of rocks and minerals made in the Laboratory of the U.S. Geological Survey during the years 1914–36. It is supplementary to Bull. 591, which contains the 2,789 analyses made up to January 1, 1914. In the present compilation, for which R. C. Wells, the present chief chemist, is responsible, the details of 1,533 additional analyses are given, including 444 of igneous and crystalline rocks; 303 sedimentary rocks; 115 clays and soils; 156 ores and gangue materials and 515 minerals. Although many of the analyses have already been published, a considerable number have not hitherto been recorded. Moreover, those published are very widely scattered, and some of them would be impossible to find without a great expenditure of time. The Bulletin is therefore likely to be of great value to petrologists and mineralogists. No attempt is made to recalculate the average composition of the earth's crust, but Fersman's figures for the abundance of all the elements—based on the whole of the data available up to 1932—are reproduced from their relatively inaccessible Russian source. Attention is directed to Fersman's new term *clarke* to designate a unit for indicating the relative abundance of an element, either by weight or by number of atoms, in any particular type of rock or in the earth's crust, in honour of F. W. Clarke, who did so much for geochemistry, especially on the statistical side.

Size of Particles Responsible for Ferromagnetism

DIA- and para-magnetism can be explained almost entirely on the basis of the magnetic properties of single atoms; but the phenomena associated with ferromagnetism only appear in aggregates of atoms arranged in a certain manner. These aggregates, it is estimated, should be of ultra-microscopic dimensions. It is therefore to be expected that a study of the structure of aerosols of iron and nickel with the ultra-microscope should yield some information on the size of the elementary magnets of these ferromagnetic substances. Observations by this method are reported by D. Beischer and A. Winkel (*Naturwiss.*, **25**, 420; 1937). The nickel and iron aerosols were produced by the thermal decomposition of nickel tetracarbonyl and iron pentacarbonyl, respectively, in nitrogen. Examination of the aerosols under the ultra-microscope showed that the particles were chain-like. This is unusual for this type of sol, which more often forms spherical aggregates, chain-like particles being formed only when some directive force is operative. It is suggested that the force in this case is magnetic. The view is supported by the fact that the velocity of aggregation is considerably greater than is usual with aerosols, and that if the aggregation takes place at a temperature above the Curie point, no chain-like particles are observed, but aggregation results in the formation of spherical particles. Estimation of the size of the smallest particles of which the chains are composed from the widening of the Debye-Scherrer diagram gives results which are in agreement with the requirements of the Weiss-Heisenberg theory of ferromagnetism. Experiments are also described which indicate that the magnetism of the particles is spontaneous, and not induced by the earth's field.

Polymorphic Changes of the Alkaline-Earth Carbonates

AN interesting application of Hahn's emanation method of investigating changes of structure of solids has been made in the examination of the polymorphic changes of calcium and barium carbonates (K. E. Zimens, *Naturwiss.*, **25**, 429; 1937). The curve of amount of emanation evolved against temperature indicates a transition in the case of calcium carbonate from the aragonite to the hexagonal calcite structure at about 500°. The change is monotropic. Barium carbonate shows an enantiotropic change at 800° from the rhombic to the hexagonal form. A further transformation at 982°, which has been reported in the literature, could not be detected.

Mud Fluid for Pressure Drilling Conditions

A HEAVY loaded mud should be used in conjunction with pressure drilling equipment when very high pressures are to be dealt with. Also, it may be convenient to use a mud of this description in circumstances where pressure could be controlled equally effectively either by back pressure or by a loaded mud fluid, for in the event of a formation being encountered where a higher pressure exists such pressure can be immediately controlled by increasing the back pressure applied at surface. Dr. J. T. Evans, in a paper presented to the Burma Branch of the Institution of Petroleum Technologists on May 4, pointed out that the preparation of loaded muds has two stages: mixing clay or shale with water to give an ordinary rotary mud and afterwards mixing barytes with this mud until the desired weight is achieved. It is clear that the desired final characteristics of the mud must determine the type of shale or clay to be used, but the clay best suited for a loaded mud base is not necessarily that best suited for an ordinary mud, since if ordinary mud should become viscous at slightly higher weight it would involve heavy expenditure on barytes to produce the final loaded product. This factor and the properties of weight, stability, viscosity and reaction to chemicals used to reduce viscosity should all be taken into consideration when preparing a specification for loaded mud. Then again, conditions are materially altered when the mud is put into service. Pressure, temperature, etc., are liable to have some effect on the characteristics of the mud, and these factors must be borne in mind when assessing the usefulness of a given loaded mud. Finally, it is quite probable that the admixture of drilling mud with formations penetrated and the phenomenon of thixotropy, whereby alternating gel and sol conditions are produced, will alter the characteristics of the loaded fluid in service.

Science and the Conservation of Food[*]

AGENCIES AFFECTING FOODS

THERE are many agencies, biological, chemical and physical, which may affect foodstuffs, either by spoiling their appearance or rendering them unfit for consumption. Bacteria are most important among the biological factors, but yeasts and moulds, which may either aid or hinder preservation, have also to be considered ; and then there are such animal pests as sugar- and cheese-mites, moths, rats and beetles, all of which may damage the raw material used in food manufacture, or attack the finished products.

Food products have also to be protected from heat, dampness, the oxygen of the air and sometimes from light as well. These last two factors, acting in association, produce the bleaching or discoloration which is sometimes seen in bottled fruit, when pieces of the fruit project beyond the syrup into the space at the top of the bottle. Then again, canned food must be protected from the action of acids and salts which might corrode the tin.

There are also substances contained in the foodstuffs themselves which may have a destructive action, namely, the enzymes. These are present in both vegetable and animal cells, but they can exist independently of them. One enzyme having an important bearing on food preservation in connexion with jam-making is pectase, which, if it is allowed to do so, will destroy the pectin which is responsible for the 'setting' property of jam. Jams, in fact, present a number of problems to the manufacturer, and the way he has been helped to solve these is a good example of the assistance which science has rendered to industry.

JAMS

Substances of importance for the keeping quality of jam are held in solution in the water it contains, for example, sugar, acids and salts. The osmotic pressure of these substances, the sugar in particular, can be responsible for protecting the jam from the growth of moulds, because, for germination, a mould spore must first absorb water. If the osmotic pressure of the jam is equal to or greater than that of any spore which falls upon it, either no water will pass from the jam to the spore or the spore will lose water and so dry up and eventually die, and in both these cases its further development will be arrested. The British Food Manufacturers' Research Association has actually determined the minimum percentage of solids necessary to bring about this condition.

There is, however, still a risk of moulds developing in a jam if the relative humidity of the atmosphere to which it is exposed is above 82 per cent.. Then the jam will absorb moisture and so its osmotic pressure becomes lower than that of the mould spores.

Another defect frequently arising in jams is crystallization or granulation of the sugar. In the jam-making process, sucrose is inverted by the boiling acid, and it is necessary that just the right degree of inversion should take place if no crystallization is to occur. Thus, if the sugar is under-inverted too much sucrose is left and this crystallizes out. If, on the other hand, it is over-inverted, too much dextrose is formed and this crystallizes out. As fruits vary very much in the amount of acid they contain, the manufacturer must be able to discover the degree of inversion taking place, and modify his process accordingly.

The setting property of jam has already been mentioned, and it is important to remember that unless jam is properly set it cannot be transported and handled. It is therefore necessary to make use of the pectin naturally occurring in fruit cells. Pectin is a complex of different substances, and therefore its properties vary from one fruit to another ; for this reason the setting properties of some fruit juices are superior to those of others, for example, gooseberry, red currant and apple are good, while strawberry is poor. Now, pectin must be protected from the naturally occurring enzyme, pectase, which destroys it. So long as the cell structure remains intact, the pectase does not attack the pectin, but in fruit which has become damaged by bruising, the pectase appears to get out of control, and in the case of raspberries all the pectin may disappear in twelve hours. In this fact lies the justification for manufacturers using "added fruit juice" or "pectin" in the making of jam.

Pectin may also lose its jellifying powers by the action of prolonged heat. It is therefore necessary to eliminate any over-heating in the manufacturing process, and this is not always easy when large quantities of liquid have to be dealt with.

MEAT PRODUCTS

The processes of jam-making are more familiar to the public than those of meat preservation. An important difference to bear in mind is that meat has no natural acids to assist the preservation process. Meat, if it is to be kept, must be protected from putrefactive bacteria, which though harmless in themselves feed upon animal and vegetable debris, gradually converting them into ammonia and carbon dioxide, etc.

Refrigeration deprives the bacteria of water which is necessary for their growth, the water in the meat tissues being converted into ice. The bacteria are not necessarily killed, but their development is inhibited. Some of the bacteria can grow at temperatures around freezing point, and for this reason chilled meat cannot be kept so long as meat which is frozen at temperatures well below freezing point. The growth of bacteria can also be restrained by certain concentrations of carbon dioxide in the air.

Although the spores of some bacteria are highly resistant to heat, it has been possible to use heat sterilization as a method for meat preservation. It is, of course, necessary for the manufacturer to know the combinations of time and temperature at which all spores likely to be present will be destroyed.

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[*] Substance of a Friday evening discourse delivered at the Royal Institution on April 16, by Mr. T. Macara, director of research of the British Food Manufacturers' Research Association.

Allowance must be made, when the product is packed in a tin, for the penetration of heat to the deepest parts of the package; and the rate of penetration will vary considerably with the density of the contents, being much slower for meat than for a tin of fluid.

FOOD POISONING

A product canned by correct processes is one of the safest articles of diet it is possible to have, and many complaints made to manufacturers that their products have caused illness, have shown on investigation to have no justification. According to Prof. Tanner of Illinois (speaking at the Congress of Microbiology, 1936), in the past canners and distributors have tried to avoid publicity by settling their claims out of court. Medical practitioners are often unfamiliar with the procedures necessary to establish definitely the causative factors in food poisoning. There is also much prejudice on the part of the public as well as ignorance of the great care generally taken in the manufacture of these products. It has been shown in Great Britain and the United States that by far the largest number of cases of food poisoning are caused by foods which have been prepared in the home or by products sold in a pre-cooked condition, but not sterilized.

TINPLATE CONTAINERS

A difficulty, still not completely solved, is that of producing in commercial quantities the perfect tinplate for the construction of a can, or tin stopper for a glass jar. Then also, the machinery necessary in making the can may break the tin coating and expose the base metal, iron. The iron thus exposed may be attacked by the salt present in meat and vegetable products. An attempt has been made to produce a lacquer which when applied to the tinplate would prevent this action. Several difficulties have so far prevented the realization of this ideal.

PRESERVATION OF MEAT

The preservation of meat by means of salts has long been practised, but only recently have its scientific principles been studied. The production of colour as well as preservation from putrefaction is brought about by the use of saltpetre. Bacterial action converts the nitrate of the saltpetre into nitrite, which combines with hæmoglobin, and when the meat is boiled the latter is converted into nitrohæmochromogen, which has the bright red colour characteristic of properly cured silverside. The micrococci responsible for this action can grow in media containing as much as 20 per cent of salt, in which concentrations the putrefactive bacteria cannot exist. Nor can their spores develop in media containing as much as 10 per cent of salt.

CHOCOLATE AND CONFECTIONERY

Changes in atmospheric temperature and humidity are liable to produce changes in chocolate and confectionery. The British Food Manufacturers' Research Association has given manufacturers a great deal of help in determining the conditions necessary for the production and storage of satisfactory chocolate. In the factory, it is generally possible to secure these conditions, but in retail premises it is not so easy. If the manufacturer were able to deliver his goods direct from his warehouse to the consumer, defective products would not be so commonly seen as they are at the present time.

Conduction of Electricity in Solids

CONFERENCE AT BRISTOL

A CONFERENCE on the "Conduction of Electricity in Solids" was held at Bristol on July 13–16 under the joint auspices of the Physical Society and the University of Bristol. The discussions were opened by R. W. Pohl, who gave an account of the fundamental work on electron conductivity and photochemical processes in alkali-halide crystals carried out in his laboratory at Göttingen. The paper was mainly concerned with the properties of crystals which have been coloured either by heating in alkali vapour or in other ways, introducing colour centres called '*F*-centres'. A discussion followed on the exact nature of these *F*-centres, and, although there is as yet no certainty on this point, a hypothesis was proposed which seemed to have a good deal to recommend it, namely that an *F*-centre is an electron localized at a point in the lattice where a negative ion is missing.

Papers on phosphorescence in halide and sulphide crystals were given by R. Hilsch (Göttingen) and J. T. Randall (General Electrical Co., Ltd.) who discussed to what extent this phenomenon is related to photoconductivity and to the transference of an electron to a large distance from the phosphorescent centre.

J. H. de Boer (Eindhoven) gave a paper by himself and E. J. W. Verwey on semi-conductors with partially filled 3*d*-bands. He pointed out that the electron theory of metals in its present form is not applicable to a substance such as nickel monoxide, in which a 'band' of electron states is incompletely filled, and therefore ought to behave like a metallic conductor, but which has in fact a resistance some 10^{9} times greater than a metal. Both he and R. Peierls gave indications of the way in which the theory would have to be modified to include these substances.

Subsequent papers dealt with conduction in metals. G. Borelius gave an account of the work carried out at his Institute in Stockholm on the resistance of alloys, and especially of alloys in which the atoms can take up an ordered or disordered arrangement. His own pioneer work on the treatment of this problem from the point of view of thermodynamics is described. W. L. Bragg gave a paper by himself, C. Sykes and A. J. Bradley on the work carried out at Manchester on the same problem.

C. H. Desch (National Physical Laboratory) gave a paper on age hardening alloys with special reference to their resistance. A. J. Bradley also mentioned his recent work on the crystal structure of the permanent magnets in the iron-nickel-aluminium alloy series, and in consequence of this a very definite model was proposed for the age hardening process, the atoms present in solid solution being supposed to collect together in groups still forming part of the crystal lattice of the original alloy. Such a process sets up intense strain, and hence hardens the alloy.

The final day was devoted to a discussion of the resistance of thin metallic films. After an initial paper by G. I. Finch (Imperial College of Science and Technology) on the structure of these films as revealed by electron diffraction, E. T. S. Appleyard gave a paper on work carried out in Bristol on their resistance, and A. Féry and M. J. Bernamont followed with papers on work done in Paris. A distinction was drawn between metals such as the alkalis which may form a fairly uniform layer over the surface upon which they are deposited, and metals such as mercury which apparently form islands. The mechanism by which the atoms can wander on a surface and form islands was discussed by J. E. Lennard-Jones. A point upon which no agreement was reached was the negative temperature coefficient of resistance of some films, and whether it is due to occluded gases.

Full reports of the principal papers given at this meeting, together with a summary of the discussions and the main conclusions reached, will be published in September in a special number of the *Proceedings of the Physical Society*.

Beginnings of Western Science in Japan

AT the fellows' dinner held at University College, London, on April 30, Prof. Joji Sakurai, emeritus professor in the Imperial University of Tokyo, president of the Imperial Academy and of the National Research Council of Japan, replied to the toast of the new honorary fellow. In the course of his remarks, Prof. Sakurai said:

"If what I have been able to do in my work in Japan is at all creditable, the credit must be traced back to my education in England and, first and most of all, to the scientific training I received in University College during the five years extending from 1876 until 1881. Dr. Alex. W. Williamson, renowned throughout the whole world for his classical investigation on the formation of others and renowned also for his remarkably keen insight into the atomic constitution of matter, was then professor of chemistry, and it is needless for me to say how highly I value the scientific training I received from him. I was taught physics by Prof. Carey Foster and Dr. Oliver Lodge, and the knowledge of physics thus acquired was a great help to me in following the remarkably rapid development of physical chemistry which was soon to come.

"It was, however, not the scientific training alone that I received in England. The five years of my student life in England were in the latter half of Queen Victoria's reign, a period which is one of the most glorious in the whole history of England. It was a period in which some of the greatest and most illustrious of men and, also, of women were to be met with in almost every field of human activity. As statesmen and orators, Lord Beaconsfield and the grand old man—Mr. Gladstone—were shining like stars of first magnitude; Tennyson was being adored as poet laureate, Ruskin as a writer and critic and George Eliot as a feminine novelist of unusual talent; Charles Darwin was enjoying to see his life-long labours bearing fruit, Herbert Spencer was laying a scientific foundation of sociology, whilst Henry Irving and Ellen Terry were, night after night, drawing crowds of enthusiastic audiences to the Lyceum.

"Having had the rare fortune of being in England at such a glorious time, I could not, and would not, confine myself to scientific studies alone, but wishing to look upon England with more widely opened eyes I studied something of English history, of English literature, of English art and, even, of English drama. At the same time, I had the great good fortune of making some very dear and life-long friends and, through them, of knowing something of English homes and of mixing more or less in English society, all of which combined in enabling me to get a fairly accurate idea of English culture, and it was this—the knowledge of English culture—which has proved to me to be of inestimable value throughout the whole of my later life. If, therefore, my work in Japan is worth mentioning, it is to be wholly attributed to the scientific and cultural training I was able to receive during the five years of my student life in England.

"I should like to make a short reference to an important fact in the recent history of Japan, concerning Anglo-Japanese cultural relations. A few years before the Restoration, that is about seventy-five years ago, a group of five young men from Choshu came over to London in one of the sailing vessels owned by Messrs. Jardine, Matheson & Co. of Yokohama, whose correspondents in London were Messrs. Matheson & Co. The object of these young men was to make a general study and observation of Western civilization and when, after a long voyage round the Cape of Good Hope, they arrived in London they were introduced to an elderly gentleman who took every care of them and helped them in every way in their study and observation. This elderly gentleman was no other than Dr. Williamson of University College under whom, as I said before, I was a student for five years. As to what made him particularly interested in these young men and in Japan I can say nothing, but I remember him often telling me that Japan was England of the East, by which, as it appeared to me, he meant something more than mere geographical likeness of the two island empires.

"Returning to the five young men, two of them went back to Japan in the following year in consequence of important developments at home, and plunged themselves in the great political turmoil which soon led to the Restoration. One of these two men was Shunsuke Ito—later, Prince Hirobumi Ito—who was generally regarded as the founder of modern Japan, and the other was Bunta Inoue—later, Marquis Kaoru Inoue—who was cabinet minister in the Meiji Government on several occasions. The other three also greatly distinguished themselves and occupied important positions in the new Government. Of these, Yasuke Nomura—later, Viscount Masaru Inoue—who, by the way, was living with Dr. Williamson's family for several years, laid and ran the first railways in Japan, Yozo Yamao—later, Viscount Yozo Yamao—greatly contributed towards laying the foundation of technical education, and Kinsuke Endo was, if I remember rightly, the first master of the mint.

"Now, the most important item in the policy of the Meiji Government was the transplantation of Western sciences, the elements of which were taught by missionaries. But as time came for higher scientific education, need was felt for teachers properly equipped with the necessary knowledge and ability, and the Government naturally decided to call these teachers from England. Strange as it may appear to-day, these calls were made through the firm of Messrs Jardine, Matheson & Co. in Yokohama, which transmitted them to their correspondents in London, and the latter invariably consulted with Dr. Williamson or somebody else named by him. The fact that Dr. Williamson intervened in the transaction of this important business was most fortunate for Japan, for the young scientific men recommended by him, either directly or indirectly, for the Japanese posts all proved themselves to be most capable teachers of science, among whom the names of William Ayrton, Edward Divers, Alfred Ewing, John Milne and John Perry may especially be mentioned as those who, later, all became fellows of the Royal Society of London. These pioneers of science in Japan taught their students to study science for its own sake, themselves setting examples by numerous brilliant researches and thereby greatly stimulating the spirit of original scientific work. I am particularly happy to have been given an opportunity this evening of making reference to this little piece of history, which is almost completely unknown, but which shows how much Japan owes to Dr. Williamson and, through him, University College and England for the valuable help given in the earlier and most important stages of development of modern sciences in Japan.

"Ever since the foundation of Ramsay fellowships in 1920, Japanese Ramsay fellows have, if I remember rightly, without a single exception come to work under Prof. Donnan, with whom the cultural obligations Japan owes University College and England have thus been happily revived".

International Association for European Ethnology and Folklore

CONFERENCE AT EDINBURGH

THE International Association for European Ethnology and Folklore was formed in November, 1935. Its first Congress was held in the New College, Edinburgh, on July 14–21. The Scottish Anthropological and Folklore Society acted as hosts.

Seventy-six delegates registered as members of the Congress, the countries represented being Great Britain and Ireland, Sweden, Norway, Denmark, Finland, Lithuania, Estonia, Holland, Belgium, Switzerland, and the United States.

At the opening of the Congress, the presidential address was delivered by Prof. Herman Geiher, of the University of Uppsala. Thirty-one papers were read. Those dealing with folklore included "Remarks upon Methods of Surveying and Making Distribution Maps in the fields of Dialect and Folklore", by the president; "Scottish and Norwegian Ballads", by Prof. K. Liestøl, Oslo; "Norse and Gaelic Folklore", by Dr. R. Th. Christiansen, Oslo; "The Stars in Eskimo Folklore", by Prof. W. Thalbitzer, Copenhagen; "Rites", by Dr. C. W. von Sydow, Lund; and "The Origins of the Ducking-stool", by Prof. J. W. Spargo, Northwestern University, U.S.A.

Papers of technological and museum interest were "Simple Agricultural Implements of England", by Mr. R. U. Sayce, Manchester; "The Early History of Vehicles in Northern Europe", by Dr. G. Berg, Stockholm; "The Irish House", by Dr. Åke Campbell, Uppsala; and "Scandinavian Folk Museums", by Prof. Sigurd Erixon, Stockholm.

On the linguistic side, Dr. W. Grant, Aberdeen, dealt with "The Scottish National Dictionary"; Mr. J. C. Catford, Edinburgh, with "Scottish Dialects and the Proposed Linguistic Atlas of Scotland"; Dr. G. S. Lowman, Brown University, U.S.A., with "The Linguistic Survey in the U.S.A. and Canada". Dr. R. Nordenstreng, Uppsala, made some helpful suggestions as to the solution of an ethnological problem in his paper on "The Riddle of the Finns, Frisians, and Fair Broad-heads".

Among papers of particularly Scottish interest was that by Mrs. M. Macleod Banks, president of the Folklore Society, on "The Three Marts and the Man with the Withy".

During the Congress, a 'ceilidh', arranged by Miss J. Bruce, secretary of Highland Home Industries, Ltd., was performed by a group of Gaelic-speaking women; and a display of authentic Scottish country dancing was given at Roslin by a team of 'bondagers' under the supervision of Mr. Ion C. B. Jamieson.

Throughout the congress, there was on view an exhibition of ethnological and folkloristic material, of which the outstanding feature was the display of photographs and drawings of house-types and domestic and agricultural implements selected from the collection of the Irish Folklore Commission. Other exhibits were by the Landsmålsarkivet, Uppsala; the Nordic Museum, Stockholm; H.M. Office of Works; and Highland Home Industries, Ltd.

University Events

London.—Sir Robert Pickard, director of the British Cotton Industry Research Association, and a member of the Senate since 1926, has been elected vice-chancellor for the remainder of the year 1936–37 and for the year 1937–38. He succeeds Mr. H. L. Eason, who took up his duties as principal on July 1. Prof. J. C. Philip has been appointed deputy vice-chancellor for the year 1937–38.

Dr. William Wardlaw has been appointed to the University chair of physical chemistry tenable at Birkbeck College as from October 1. Since 1918 he has been on the teaching staff of the University of Birmingham and has held the post of senior lecturer in chemistry since 1926.

The title of professor of morbid anatomy in the University has been conferred on Dr. G. R. Cameron (Melbourne), in respect of the post held by him at University College Hospital Medical School, and that of reader in chemistry in the University on Mr. Henry Terrey, in respect of the post held by him at University College.

The degree of D.Sc. has been conferred on the following: G. P. Crowden, university reader at the London School of Hygiene and Tropical Medicine (applied physiology), G. E. R. Deacon (chemistry), G. S. Hartley (chemistry), H. L. Chhibber (geology), Dr. W. F. Whittard (geology), Marion G. Eggleton (physiology), T. H. C. Taylor (entomology), R. A. Frazer (mathematics) and H. O. Bull (zoology).

Manchester.—Among the numerous appointments announced at the end of this session is one of somewhat unusual interest—that of Mr. A. D. Ritchie, at present lecturer in physiological chemistry, to the Sir Samuel Hall chair of philosophy and public administration in succession to the late Prof. J. L. Stocks. Mr. Ritchie took first-class honours in philosophy at St. Andrew's in 1911, and second-class honours in Part I Natural Sciences Tripos at Cambridge in 1914. He was elected fellow of Trinity College, Cambridge and worked on the philosophy of science, and was Tarned Lecturer in 1935. Though for the last twenty-three years he has been professionally engaged as a teacher of physiology, he has published various philosophical works in this period.

The following further appointments have also been announced: Prof. P. M. S. Blackett, professor of physics in Birkbeck College, University of London, to succeed Prof. W. L. Bragg in the Langworthy chair of physics; H. Davenport, P. Du Val and W. W. Sawyer, assistant lecturers in mathematics; G. D. Rochester, assistant lecturer in physics; D. G. Evans, assistant lecturer in chemistry in the Department of Bacteriology; E. L. Patterson, assistant lecturer in anatomy; and Miss Margaret I. Williams, assistant lecturer in applied physiology.

Sheffield.—The following appointments have recently been made: J. W. Watson to be assistant lecturer in geography; Gilbert Forbes to be lecturer in forensic medicine; J. M. Kennedy to be lecturer in infectious diseases; G. A. de Belin to be assistant lecturer and research assistant in the Department of Metallurgy.

St. Andrews.—A lectureship in political science has been instituted in the United College, St. Andrews, and Mr. J. M. Brown of Glasgow has been appointed to the new post. Mr. B. S. Robertson has been appointed lecturer in regional anatomy in University College, Dundee.

Science News a Century Ago

The Diet of Silkworms

At a meeting of the Paris Academy of Sciences on July 31, 1837, reported in the *Gazette Médicale de Paris* of August 5, MM. Moriset, de Clavaison and Durrand recorded the results of an experiment on the feeding of silkworms by substituting for mulberry leaves those of the Spanish *scorsonera*. The silkworms which had been so fed from the time that they had been hatched did not appear to suffer from this diet, and had produced cocoons which were in no way inferior to those of silkworms which had been given mulberry leaves at the same time. Some of the cocoons had been sent to the Academy, but did not appear to competent judges to be the product of healthy silkworms. Similar trials had previously been made at different times with the leaves of *scorsonera*, and had always been abandoned. In any event, what had encouraged the speakers to pursue the experiment was the fact that the silk industry would never acquire a great development in the south of France so long as silkworms were fed exclusively by mulberry leaves, in view of the fact that cultivation of the mulberry tree did not harmonize with the other principal cultivations in the country; whereas cultivation of *scorsonera* did very well and would yield a double profit, the root forming a wholesome food similar if not preferable to salsify root.

Hospitals in Russia

A paper in the *British and Foreign Medical Review* of July 1837 on the present state of medicine and medical institutions in Russia by Dr. George Lefevre, late physician to the British Embassy at St. Petersburg, contains the following account of the hospitals in that country: "Although few countries can boast of finer institutions for the sick and infirm than Russia at the present day, it has nevertheless been the work of nearly two centuries to bring them to their actual state of perfection. Commenced by a private individual, whose example was soon followed by Government, they only began to have a character of importance under Peter the Great. . . . As regards the external appearance of the hospitals in Moscow and St. Petersburg, they are splendid in the extreme, resembling more the palaces of princes than the abodes of the sick. But it is of their discipline we have to speak, and many of the regulations of these institutions are worthy of imitation by similar establishments in other parts of Europe. One great advantage they possess over charitable institutions of a similar kind in England is the *daily* admission of patients, the vacant beds being immediately occupied by the most urgent cases. All applicants are not admitted indiscriminately into the General Hospitals; for there are others devoted to the reception of particular diseases, as eruptive fevers, venereal diseases, etc., and persons labouring under diseases which are considered incurable are not treated in the hospitals but are admitted to almshouses. . . . As regards the internal arrangements there is no cause for complaint. The wards are spacious and lofty, the beds not too much crowded together and cleanliness is carried to a point almost deserving of ridicule. . . . The most decided defect in all these institutions is a thorough disregard of ventilation."

The Botanical Society

AT a meeting of the Botanical Society held on August 3, 1837, the secretary read a letter from the Botanical Institution of Brussels requesting it might be admitted into friendly correspondence with the Society. Mr. Dennes then read a paper entitled "Observations on the Structure and Germination of the Reproductive Organs of Marsilea". The paper was accompanied by a translation of a memoir on the same subject, made to the Paris Academy of Sciences by MM. Mirbel, Dutrochet and St. Hilaire. In *M. quadrifolia* (which much resembles our common trefoil, excepting in its petals being furnished with an additional leaf) there is apparently a longitudinal membranous partition, containing a number of cells each enclosing an hermaphrodite flower. The stamens of these flowers are stated by Jussieu, who was the first to examine the plant minutely, to be so small, and in such numbers, as to render it impossible to count them: they open transversely, to scatter the grains of the spherical yellow pollen. Convincing proofs were adduced from the researches of Dutrochet and St. Hilaire especially, that germination takes place by the impregnation of the ovules with the antheric dust, although this has been strongly opposed by other botanists, who keep all the species of *Marsilea* in the class Cryptogamia.

The *Athenæum* and Meteorology

IN its issues of August 5 and 12, 1837, the *Athenæum* devoted several pages to an essay on meteorology, the subject being suggested by a review of two recently published works. The first of these was by Partick Murphy (1782–1847), and was entitled "Meteorology considered in its Connexion with Astronomy, Climate, and the Geographical Distribution of Animals and Plants". Of the author and this book the *Athenæum* said: "We state our firm conviction, that nothing but loss can be the result of his publishing such books as the one before us". Of the other book, Graham Hutchison's "Treatise on the Causes and Principles of Meteorological Phenomena" the reviewer remarked: "This is a sensible, well-executed compilation, interspersed with some new views and explanations of meteorological facts". The subject was one in which the *Athenæum* took a particular interest and at the beginning of the essay it said: "If there be one branch of science, more than another, which we have endeavoured to place prominently before the public, it has been Meteorology, because it appeared to us of great importance and to have been especially neglected".

The London Electrical Society

AS a result of a resolution passed at a general meeting of the Electrical Society held on August 5, 1837, the Committee issued a report stating that the object for which the Society was formed, as stated in a resolution of May 16, 1837, would be fully carried into effect. The publication of papers had been deferred, as members had intimated their intention of presenting communications, after the recess, containing new facts in electrical science. Among the communications which had already been received was one from Andrew Crosse, of Broomfield, near Taunton, describing some results obtained by him in producing crystals by transferring the electrical energy from the zinc and copper plates to other substances not metallic in contact with them.

Societies and Academies

Paris

Academy of Sciences, May 31 (*C.R.*, 204, 1597–1692).

JULES DRACH: The logical integration of linear differential equations: the reduction of the group.

MARCEL DELÉPINE and ALAIN HOREAU: The catalysis of the Cannizzaro reaction by active nickel and platinum. The application to some aldoses. The conversion of an aldehyde into alcohol and acid by alkali (Cannizzaro reaction) is greatly accelerated by the addition of a catalyst, Raney nickel or platinum. Results are given for galactose, glucose and arabinose.

PAUL VINCENSINI: The reconstitution of the ensemble of convex bodies of n dimensional space starting from certain base sub-ensembles.

ARNAUD DENJOY: A theorem of Mandelbrojt.

JOSEPH CHALOM: Reaction pumps with supersonic flow.

ASSÈNE DATZEFF: The solution of Schrödinger's equation.

JEAN LOUIS DESTOUCHES: The relativistic wave mechanics of systems and the interaction of light and matter.

HENRI MINEUR: Clusters of stars in kinetic equilibrium.

PAUL BOURGEOIS and JACQUES COX: The frequency of the concentrations in extra-galactic nebulæ detected by Hubble's tests.

LUCIEN D'AZAMBUJA: International co-operation for the continuous observation of the sun, and its first results. A summary of results obtained between July 1, 1935, and December 31, 1936. Study of the connexion between chromospheric eruptions and electrical and magnetic disturbances on the earth.

PIERRE VERNOTTE: How to formulate empirical laws. The exponential development.

HENRI LEMONDE: The interpretation of variations of viscosity with concentration in binary liquid mixtures.

RENÉ LUCAS: The thermal waves of liquids.

RENÉ PLANIOL: The application of molecular jets to the production of light ions.

JEAN P. E. DUCLAUX: The anodic polarization of tungsten. Study of the electrolysis of sulphuric acid with tungsten electrodes. The fall of current with time, due to the formation on the anode of a layer possessing a high resistance, depends on the condition of the surface, and is independent of the current.

VITOMIR H. PAVLOVIĆ: A new method for studying subjectively the mixture of colours.

MAURICE PARODI: Study of the transmission of some oxides in the extreme infra-red. Measurements for the oxides of manganese, strontium, cadmium and barium are given. The wave-lengths of the absorption bands plotted against the atomic number fall on a curve resembling a parabola.

HENRI BIZETTE and BELLING TSAI: The magnetic rotatory power of compressed and of liquefied nitric oxide, NO. The experimental results suggest that the molecules of nitric oxide commence to polymerize under high pressure at – 80° C. From the Verdet constant at – 163° C., it is concluded that 93 per cent of the liquid is in the state of double molecules $(NO)_2$, and this agrees with the results of Rice, based on the entropy of vaporization.

P. BONÉT-MAURY: The utilization of photo-elements with semi-conducting layer for radioactive measurements. Selenium or copper photo-cells, irradiated with α- or β-rays, give rise to a difference of potential, exactly as with photons; the γ-rays have given no appreciable effect. The local variations of sensibility and the effects of fatigue of the element are more marked with α-rays than with photons.

Mme. Juliette Gavoret: The quantitative study of the adsorption of metallic cations by cellulose. The iso-electric point of cellulose.

Mlle. Suzanne Veil: The potential gradient of gelatine under electromotive force.

Casimir Jausseran: The anomalies of the dispersion of light by colloidal solutions of silver. Although the heterogeneity of the medium studied produces special optical properties, its refractive index can be calculated utilizing for the dispersed metal the same optical constants as those of the metal in the massive state.

Mlle. Marie Théodoresco: The study by the Raman effect of two molybdotartaric complex compounds in water. The results are in agreement with those found by the rotatory polarization, namely, the existence of two complex compounds, $Na_2(TH_2,MoO_3)$ and $Na_4(2TH_2,MoO_3)$.

Ch. Bedel: The determination of the solubility of slightly soluble electrolytes, precipitated and in the presence of their reaction products. Application to silver chloride.

Michel Cymboliste: The structure of electrolytic chromium.

Pierre Mastagli: The reducing and condensing action of alkaline benzylates on ketones and aldehydes, and on the α, β unsaturated alcohols.

Mlles. Marthe Montagne and Marguerite Garry: The action of organo-magnesium compounds on the phenylimino derivatives of benzil.

Charles Bouhet: The Raman effect in circularly polarized light in quartz, observed along the optic axis.

Louis Dubertret: The constitution and genesis of the green Syrian rocks.

Daniel Barbier, Daniel Chalonge and Etienne Vassy: The variations of temperature of atmospheric ozone according to its origin.

Josué Heilmann Hoffet: The genus *Trigonoides*, a stable genetic mutation of the genus *Trigonia*.

André Eichhorn: Chromosome enumeration and the study of mitosis in two *Crotolaria*.

Jean Trochain: A new graphical representation of the results of physical and granular analyses of the soil.

Mme. Marguerite Combes: The probable existence of a higher class, not differing in appearance, forming the true workers in the Formica.

Tchou Su and Chen-Chao-Hsi: A new Chinese race of *Ascaris megalocephala* (type *trivalens*).

Pierre P. Grassé: Aberrant spermiogenesis of the Metatermitides.

Jehan Vellard: Geographical variations of the venom of the South American rattlesnake, *Crotalus terrificus*.

Henri Bierry: Protein sugar and blood proteins in the normal and pathological states.

V. A. Kostitzin: A generalization of the biological equations in the case of a population intoxicated by the products of its chemical activity.

Jean Lavollay and Mme. Françoise Laborey: The mathematical expression of the development of *Aspergillus niger* as a function of the concentration of magnesium of the nutritive medium.

Marius Chadefaud: The organization and the trichocytes of *Gonyostomum semen*.

Henri Simonnet, Gustave Guittonneau, Germain Mocquot and André Eyrard: The influence of pasteurization in the absence of air on the nutritive value of milk. The experiments described lead to the conclusion that pasteurization in the absence of air is not incompatible with the preservation of the essential nutritive qualities of milk.

Amsterdam

Royal Academy (*Proc.*, 40, No. 6, June 1937).

L. S. Ornstein: Scattering of neutrons in matter (5). A discussion of the distribution of the directions of motion of neutrons scattered by protons.

J. A. Schouten: The differential geometry of the groups of contact transformations (3). Infinitesimal doubly homogeneous contact transformations and their applications to mechanics and electrodynamics.

F. M. Jaeger, J. A. Bottema and E. Rosenbohm: Exact measurement of the specific heats of metals at high temperatures (28). The heat capacity and the electrical resistance of didymium between 300° and 600° C.

F. M. Jaeger and J. ter Berg: On pterotactic derivatives of bivalent platinum with optically active cyclic trans-1.2 diamines.

A. G. van Veen and J. K. Baars: Constitution of toxoflavin. This substance, produced by the action of *Bacterium cocovenenans*, is a di-imine containing the purine skeleton and is isomeric with methylxanthine.

O. Posthumus: Some remarks on the vegetation on the sandy soil of the Pandang Loewai (E. Koetai, E. Borneo).

S. W. Visser: A period of twenty-seven months in the rainfall throughout the world.

W. B. Deys and M. J. Dijkman: Splitting off of gallic acid from tannin, especially from theotannin by *Aspergillus niger*.

M. J. Adriani: Transpiration of some halophytes cultivated in various media in comparison with that of some non-halophytes.

H. J. Hardon: Padang soil, an example of podsol in the tropical lowlands.

G. C. Hirsch and R. F. J. van Pelt: Rhythm of the glycogen content of the liver of the white mouse.

M. J. L. Dols, B. C. P. Jansen, G. J. Sizoo and J. de Vries: Studies on phosphorus metabolism in normal and rachitic rats with a radioactive phosphorus isotope (see also Nature, June 19, p. 1068).

J. J. Duyvené de Wit: Biological evidence of two new hormones by tests on *Rhodeus amarus*.

Cape Town

Royal Society of South Africa, May 19.

K. F. M. Bright: The South African inter-tidal zone and its relation to ocean currents. (2) An area on the southern part of the west coast. (3) An area on the northern part of the west coast.

R. F. Lawrence: The odoriferous glands of South African harvest spiders. The external appearance of the odoriferous glands in some South African harvest spiders is described, as well as the colour, volatility, and smell of the secretion of the glands. The activity of the glands is considerably more marked in the large group of Laniatores, some members of which expel the secretion in the form of a fine jet. The ejection of an evil-smelling substance is most probably a defence reflex in this group of Arachnida.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned :

Assistant Lecturer in Zoology in the University College of North Wales, Bangor—The Registrar (August 7).

Teacher of Engineering in the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77, George Street, Oxford (August 14).

Lecturer in Mechanical Engineering in the Coventry Technical College—The Director of Education, Council House, Coventry (August 23).

Junior Metallurgist for the British Non-Ferrous Metals Research Association—The Secretary, Regnart Buildings, Euston Street, N.W.1.

Official Publications Received

Great Britain and Ireland

Report on the Progress of the Discovery Committee's Investigations. Pp. 52+11 plates. (London : Colonial Office.) 3*s*. 6*d*. net. [116

Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Year ended 31st March 1936. Pp. viii+136+9 plates. (London : H.M. Stationery Office.) 2*s*. 6*d*. net. [146

Forestry Commission. Bulletin No. 18 : Spring Frosts, with Special Reference to the Frosts of May 1935. Pp. 131+12 plates. (London : H.M. Stationery Office.) 2*s*. 6*d*. net. [146

Carnegie United Kingdom Trust. Twenty-third Annual Report, January-December 1936, approved by the Trustees at their General Meeting held on Friday, March 5th, 1937. Pp. vi+105+18 plates. (Dunfermline : Carnegie United Kingdom Trust.) [146

Nutrition and Health. (Gabrielle Howard Memorial Lecture.) By Sir Robert McCarrison. Pp. 26. (London and Ashford : Headley Bros.) 6 copies, 1*s*. [156

University of Oxford : Committee for Advanced Studies. Abstracts of Dissertations for the Degree of Doctor of Philosophy. Vol. 9 (Dissertations accepted during 1936). Pp. v+272. (Oxford : Clarendon Press ; London : Oxford University Press.) 3*s*. net. [156

The Animal Year Book. Vol. 4. Edited by Dr. H. E. Bargmann. Pp. vi+174+10 plates. (London : University of London Animal Welfare Society.) 2*s*. 6*d*. [166

Secondary School Examinations and the Curricula of Secondary Schools, with Suggestions for Reform. An Address delivered to the Higher Education Meeting at the Portsmouth Conference of the N.U.T., 1937, by Sir Philip Hartog. Pp. 34. (London : National Union of Teachers.) Free. [166

Proceedings of the Royal Society of Edinburgh, Session 1936–1937. Vol. 57, Part 2, No. 14 : The Genetical and Mechanical Properties of Sex Chromosomes. 3 : Man. By Dr. P. C. Koller. Pp. 194–214+2 plates. 2*s*. 3*d*. Vol. 57, Part 3, Nos. 15, 16 : Quantitative Evolution. 2 : *Compositæ Dp-ages in relation to Time* ; 3 : *Dp-ages of Gramineæ*. By Prof. James Small. Pp. 215–227. 1*s*. Vol. 57, Part 3, No. 17 : Tests for Randomness in a Series of Numerical Observations. By Dr. W. O. Kermack and Lieut.-Col. A. G. McKendrick. Pp. 228–240. 1*s*. (Edinburgh : Robert Grant and Son, Ltd. ; London : Williams and Norgate, Ltd.) [186

List of 16 mm. Science Films. Pp. 26. 4*d*. List of 16 mm. Geography Teaching and Travel Films. Pp. 38. 6*d*. List of 16 mm. History Films. Pp. 6. Free. Supplementary Catalogue of British Medical Films of Technical Interest to Medical Practitioners and Students, Jan. 1936–Jan. 1937. Pp. 16. 6*d*. (London : British Film Institute.) [17

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Systematics in Relation to General Biology

THE classification of living things is of prime importance, and fundamental to any biological research. Taxonomy, the law of order, is not only one of the oldest branches of biology, but also remains one that is basic to such more recently developed branches as cytology, ecology, and genetics. This fact cannot be too much stressed. It is somewhat unfortunate that a really satisfactory history of plant and animal taxonomy remains unwritten. The philosophical and logical principles underlying classification have also not received the consideration they deserve, and taxonomists themselves are often ignorant of the real implications of the working hypotheses they adopt. They are often also none too clear as to exactly what is implied by certain words and phrases, such as 'phylogeny' and 'a natural system', which have perhaps assumed a 'blessedness' they scarcely deserve.

Text-books of systematic biology, with very few exceptions, still define the aim of a natural classification as the reconstruction of the course of evolution, and seem to envisage the possibility of eventually producing a schematic tree on which each group hangs on its appropriate branchlet. That this conception rests on a confusion of thought has been suggested by many biologists, and its continued unqualified statement in taxonomic text-books is to be regretted. Perhaps the fullest discussion of the difficulties of equating a natural with a phylogenetic classification is contained in the late Dr. F. A. Bather's presidential address to the Geological Society in 1927, and the same point was stressed recently by Mr. J. S. L. Gilmour in his article "A Taxonomic Problem" in NATURE of June 19, p. 1040. Clear thinking on this fundamental issue is one of the most urgent needs for the future progress of taxonomic work. The older, 'orthodox', taxonomy is based mainly on morphology (including, especially for some groups, anatomy) and with the supplementary use of geographical data, notably in higher animals. This use of morphological criteria as the basis of classification has yielded remarkably valuable results, of which taxonomists may well be proud. There is also no doubt that much yet remains to be done along the well-recognized lines of morphological description and classification, especially in many groups of invertebrates and lower cryptogams and among the faunas and floras of relatively little-explored parts of the world. It will further be generally allowed by taxonomists that there is still room for improvement in their methods of comparative description, terminology, and details of classification without involving far-reaching changes.

Within the last two decades, however, there has not only been an almost startling advance in cytology, ecology, genetics, and other sub-sciences of biology, but it has also become increasingly recognized that many discoveries classified under these heads have a bearing on orthodox taxonomy. This impact of newer methods on the still essentially morphological systems of naming and arranging animals and plants can no longer be ignored. It concerns all biologists, whatever may be their particular fields of research. There is no general agreement as to whether new subsidiary systems, with their own terminology and symbolism, should be developed as independently as possible of existing taxonomy, or whether the latter can be so expanded as to include those data of cytology, ecology, genetics, etc., that can be used as 'characters' for arranging organisms into groups.

Orthodox taxonomy has developed International Rules of Nomenclature. The use of these within their proper field is not disputed, but they may, in their present form, prove a hindrance if rigidly applied to an expanded taxonomy. The possibility and desirability of developing an all-inclusive taxonomy towards an ideal state of perfection needs full investigation.

Existing taxonomy is based on grouping animals and plants into taxonomic units termed varieties, subspecies, species, genera, families, etc. There is, however, considerable disagreement, even among specialists within one group, as to the limits of the units. A general survey of the systematic categories in different groups, a classification of the criteria used, and a careful consideration of recently discovered cytological and genetical facts might well lead to obtaining greater precision, more logical arrangement, and greater uniformity in taxonomy.

Taxonomic literature is very large, scattered in many periodicals, and very diverse in presentation and contents. Museums, herbaria and other institutions contain quantities of material and data, available to the biologist, but often not in a readily accessible form for any particular piece of research. There is, indeed, an almost unrealizable mass of material and of known facts which would yield results of the greatest biological importance if only they were collated and correlated with the rest of biology. It is to be anticipated that new generalizations of considerable importance will emerge in the process. Some of the preliminary analysis has been done, but the results are scattered and uncorrelated ; the synthesis would seem to await another Darwin. The task, however, is now beyond the physical powers of any one individual.

While taxonomy is at present based mainly on morphology, its history shows that attempts have been made from time to time to incorporate new ideas. Thus, though taxonomy long antedates the general acceptance of the evolutionary principle, this had in time considerable effects on taxonomic theory and practice. Similarly, especially at the species level, peculiarities of distribution have been utilized in drawing limits between groups.

Of recent years, it has become increasingly evident that speciation is neither invariably a simple, clear-cut phenomenon nor due to any one cause or series of causes : rather, a number of factors, internal and external, operate in producing speciation and other evolutionary processes. Their relative importance in different groups needs intensive and extensive investigation. Again, many relevant facts have been published, but until the scattered data have been extracted, correlated and classified, it is impossible to tell along what lines and with what material new research is most likely to throw light on those questions of equal importance to the taxonomist, cytologist, ecologist, and geneticist. It is certain, however, that a great deal of new research is necessary before the problems even of speciation can be solved. The development of biology along synthetic lines does not mean the abandonment of analytical methods in special research. It means rather their intensification, but with a co-ordination at present largely lacking. The collection of material for the eventual publication of a British Fauna and a British Flora on uniform and broad biological lines should serve as a stimulus to research and as a focus for co-ordination.

Many kinds of biological research involve the recording and interpretation of large masses of facts. With proper help and advice, valuable work can be done by local societies, amateurs, schools and colleges. Such research, properly conducted, can have a twofold value : observations or experiments can be made over a wide area or for a long period of time ; and they are of very considerable educational value to the persons making them.

Taxonomists, and indeed other biologists, frequently complain that their subject is not well taught in universities and schools. There is much truth in this complaint, and the modification of teaching methods and syllabuses is an urgent need. Students not infrequently know much about the anatomy of a plant or animal without knowing anything about it as a living organism or its relationships to other organisms. The revivification of taxonomy by expanding its scope to include data from other branches of biology and the realization of what they can gain from taxonomy would in itself tend to encourage greater attention to its careful teaching.

That the time is ripe for increased co-operation between workers in different branches of biology will, it is hoped, be acknowledged. In this connexion the recent formation of an "Association for the Study of Systematics in Relation to General Biology", an account of which was published in NATURE of July 24, p. 163, is of special interest. The work of the Association should do much to stimulate interest and co-operation in the various aspects of the impact of modern biological thought on the problems of taxonomy.

Indian Ethnography

The Khāriās

By Sarat Chandra Roy and Ramesh Chandra Roy. Vol. 1. Pp. xv + 306 + 27 plates. Vol. 2. Pp. ii + 307–530 + lviii + 13 plates. (Ranchi: "Man in India" Office, 1937.) 11 rupees.

STUDENTS of tribe and caste in India are well acquainted with Sarat Chandra Roy's excellent studies of the wild tribes of Orissa and the Central Provinces, of which the results are contained in his works on the Mundas, Orāons, Birhors and Bhuiyas. We are now given two interesting volumes on the Khāriās, who are to be found in Orissa and the eastern portion of the Central Provinces. Following the established order of such works, particulars are given of the origin, migration, physical traits, culture, social organization, birth, marriage and death rites, festivals and superstitions. Dr. Marett gives the work a short introduction, and there are numerous illustrations.

There are three branches of these primitive people, the Erenga or Hill Khāriās, the more civilized Dudh Khāriās, and the Delki or Dhelki Khāriās. The Hill section of this tribe still live by a system of cultivation known as *Jhum* in the eastern and *Kumri* in the western provinces of India. This consists in burning down large tracts of forest and sowing scanty crops in the ashes. As the forest is destroyed by this process, the population moves to fresh areas for a source of livelihood. The other divisions of the tribe have adopted more settled forms of agriculture.

The two large volumes containing the fruits of Sarat Chandra Roy's research offer, as was to be expected, much resemblance to the accounts of similar tribal units in other parts of India. We find traces of totemism, a system of ancestor worship, the belief in and propitiation of evil spirits, a form of medicinal treatment based partly on the use of vegetable products and partly on spirit scaring, and a firm belief in omens and witchcraft. The totem section among the Khāriās is known as *Kili* or *Khili*, corresponding to the *devak*, *bedagu* or *bali* of western India. The author gives the name of many totem divisions which apparently bear close resemblance to those of similar tribes in other parts of the country; but here, it may be noted, identification is rendered difficult by lack of adequate description of the tree or animal referred to. The vernacular names are an inadequate guide, particularly in the case of trees which bear many vernacular names in different areas.

In this connexion, special interest is attached to the list contained on pp. 458–460 in vol. 2. The author is here giving his reader the names of a number of trees of which the products are used for medicinal purposes. It will be at once discovered that the botanical names are those of well-known totems of other parts of India, as for example, *Lawsonia alba*, *Phyllanthus emblica*, *Achyranthes aspira*, *Artocarpus Lakoocha*. *Bombax malabaricum*, *Eugenia Jambolana* and the well-known *Calotropis gigantea*.

The importance of this list lies in the fact that it has been often assumed that there is a close connexion between the medicinal value of certain trees and their adoption as the totem of an exogamous unit. Significance, therefore, is attached to the fact that among the Khāriās, a very primitive tribe, such value is found in the very same trees that the Marāthas and allied castes hold in totemistic relationship on the other side of India.

Russell, in his "Tribes and Castes of the Central Provinces", pp. 445 *et seq.*, describes the Khāriās as a primitive Kolarian tribe which appear to be allied to the Mundas and Savars. He considers them to be an elder branch of the Mundas. He describes them as very dirty in their persons, with features of a low character, not unlike the Bhumij, but with an absence of any strongly marked type.

In the "Linguistic Survey of India", the Khāriā language has been declared to be closely allied to Savara, and to resemble Korku and Juang. It has ceased to be a typical Munda language, according to Sir George Grierson. Sarat Chandra Roy, as was to be expected from the results of similar investigation in other areas, finds evidence that the first spirits to be personified and deified were those of ancestors. He writes:

> "This is why we find among all sections of the Munda tribes, the worship of ancestor spirits. One's parents and other near relatives whom the Khāriā loved and honoured when they were living cannot fail to be regarded with love and reverence after they were dead. Spirits of ancestors who were revered and looked up to as *Siāns* or village elders during their life-time are especially remembered and honoured after death" (p. 315).

The late Sir James Campbell, in his notes on the spirit basis of "Belief and Custom" published in the *Indian Antiquary*, held a similar theory, and proceeded to show by numerous examples collected in western India how the original practice of spirit scaring by various well-known rites developed into a system of spirit 'squaring', whereby suitable propitiation was made to the spirit and a lodging found for him where he would be content to dwell without further troubling the helpless victims of his attention. This process of propitiation for the *Dubo* or ill-disposed spirits is described by Sarat Chandra Roy. In addition to ancestral spirits, as might be expected, Khāriās worship a host of minor deities, of which details will be found in Chapter xi. Above them all is the supreme spirit known as Poromosor, an obvious corruption of the Hindu title of Parameshwar.

We must close this short notice of Sarat Chandra Roy's valuable work by an acknowledgment of the assistance such studies are to those interested in the Ethnographic Survey of India, now represented by a constantly increasing flow of works of this description. If a word of criticism may be permitted, it would take the form of a regret that so many misprints are allowed to disfigure these pages. They are quite unusually numerous, and, strangely enough, we have a consistent wrong spelling of the well-known name of the author of "Tribes and Castes of the Central Provinces". The illustrations, mostly reproductions of photographs, are greatly lacking in clearness of outline, and thus lose much of their value.

R. E. ENTHOVEN.

Afforestation in the Lake District

Afforestation in the Lake District:
a Reply to the Forestry Commission's White Paper of 26th August, 1936. By H. H. Symonds. Pp. xxi + 97 + 4 plates. (London: J. M. Dent and Sons, Ltd., 1936.) 2*s*. net.

IT is well known there has been considerable controversy over the afforestation work which has been and is being undertaken by the Forestry Commission. Mr. Symonds has written a small book dealing with the Lake District in this connexion, and Lord Howard of Penrith contributes a foreword. A joint informal committee of the Forest Commission and the Council for the Preservation of Rural England was appointed. The author details the various results of the meetings, the questions asked in Parliament and comments in the Press on the Forestry Commission's proposals.

Opposition to the proposals to afforest parts of the Lake District is based in part on the monotony of scenery introduced by commercial afforestation. "The sitka spruce and Norway spruce—the staple diet of waterlogged ground—Douglas fir, Corsican pine—how they repeat themselves; ages ago they learnt their lesson, and the 'damnable iteration' of them is an offence: they have the air of mass production, the efficiency of the machine." The author states that his book is not an argument against afforestation or conifers. But he points out that while conifer stands, after first youth, may look magnificent on the Alps, Jura or the Rockies, they are out of place in the fells of Cumberland which are on so small a scale that they "depend for their grandeur on a system of natural proportions which you can spoil, but not alter". As Lord Ullswater has said, the problem is one "of taste, discretion and degree".

If one of the reasons for planting in the Lake District was to give work to the unemployed, it would seem a pity that the Forestry Commission did not avoid controversy, for the work of the forester is exposed to many dangers on an antagonistic countryside, by agreeing to plant broadleaved trees only, and mixed woodland, as suggested by the author. Some valuable experience would have been obtained on the subject as to the elevation to which some of these species can be taken, and amenity would have been safeguarded; since the forester who knows his job should have been able to adapt his plantings to harmonize with, and not spoil, a piece of countryside the beauty of which has for long been a household word in Great Britain, even amongst many who have never seen it. It would be an interesting piece of work demanding skill and considerable knowledge; a different type of work, it may be admitted, from the monotonous planting of young conifers on a more or less uniform pattern. The question of the longer period the nation would have to wait for a return in money does not appear to be of so great importance in the Lake District, where other advantages are already being reaped.

The author puts up a strong plea for the preservation of the sheep farming and the Herdwick strain, both of which must disappear with any considerable afforestation in the Lake District owing to the fact that of necessity all the lower ground would be planted up, and thus the sheep disturbance would be complete. The Forestry Commission planting proposals will involve the displacement of more than 5,000 of this local breed of sheep.

Mr. Symonds also deals categorically with the question of the extra unemployed that the scheme would provide for and the question of small holdings. On both these subjects he displays ample local knowledge, and his remarks on the subject of the prospects before the small holder, especially of one unacquainted with the locality, merit consideration.

Mr. Symonds' little book appears to sum up the present position. To many, the Lake District is a thing apart; and when the total area involved and the comparative small size of the conifer woodlands to be established is taken into account, it would appear that the Forestry Commissioners here have the chance of justifying the useful position they have taken in the country by leaving the beauty spots alone, and planting, where planting must be, with hardwoods.

Insect and Allied Pests of Fruits

The Pests of Fruits and Hops

By Dr. A. M. Massee. (Agricultural and Horticultural Handbooks.) Pp. 294 + 27 plates. (London: Crosby Lockwood and Son, Ltd., 1937.) 15*s*. net.

THE production of profitable fruit crops is dependent upon a variety of factors, some beyond the control of the grower, others being within his control. The factor of pest incidence in an orchard or plantation is one of extreme importance, for while the occurrence of some species—resident pests—are within the plantsman's control, others—migratory pests—are to an extent beyond control, and the presence of the latter group are frequently undetected until irreparable damage is committed.

Great advances in fruit culture have been made during the past twenty years, and an increasing number of scientific investigators are engaged upon the elucidation of problems connected with this important industry. Entomologically speaking, the changes have been great both as regards new and troublesome pests, namely, capsid bugs, fruit tree red spider mite, and tarsonemid mites; the appreciation of virus infection and the part played by insects in their transmission; the measures for controlling pests by the introduction of tar-distillate egg-killing washes, petroleum oils, and *Derris* and *Pyrethrum* preparations; and the evolution of high-powered machinery for the application of insecticidal and fungicidal washes and dusts.

It may appear strange that this much-needed volume is only the third standard work dealing with the pests of fruit which has appeared in forty years. To those, however, who are familiar with Miss Ormerod's "Handbook of Insects Injurious to Orchard and Bush Fruits", published in 1898, and with the monumental work of Prof. Theobald, published in 1909, it is less curious, for these authors produced works which were classics in their particular line.

The present author, while purposely omitting technical descriptions of insects, has attempted to place before fruit-growers and students a simple and brief account of some of the more important insect and allied pests that occur on top and soft fruits and on hops. Simplicity of expression is a matter of degree, and while the specialist may consider the account of the several pests to be simple, the layman may think otherwise.

Technicalities are wisely omitted, but the inclusion of some information relative to the more important orders of insects and allied animals would have allowed the lay reader to appreciate the varied life-cycles, feeding habits, and metamorphoses of the several groups of arthropods mentioned in the text. Again, the inclusion of a simple key, with figures, to the larval stages of insects, would enable the practical man to differentiate between the larvæ of the Endopterygota without seeking for such information in the body of the work.

The volume is well illustrated with more than a hundred photographs taken by Mr. R. M. Greenslade, who is Dr. Massee's colleague at the East Malling Research Station. An author would prefer to have the illustrations placed near the description of the pest, and it is unfortunate that publishers frequently fail to attain this desirable end. One example will suffice, namely Plate iv (facing p. 36) illustrates bark beetles and shot hole borers and the damage committed by them, but these pests are described on pp. 181–183—an unfortunate misplacement.

To illustrate insect species without descriptive matter is of little value either to the specialist or to the fruit-grower, for while the former is taught not to depend on an illustration for purposes of identification the latter is tempted to make his specimen fit the figure. For example, Plate viii illustrates eight species of tortricid moths, but one fails to find any description of the several species on pp. 60–66.

Careful proof-reading has reduced the number of errors to a negligible quantity, and the inclusion of three indexes—scientific, popular, and author—is of immense value both to those who read and to those who scan a textbook.

The author is not hopeful of the standardization of scientific names of insects. The laws of priority must of necessity be obeyed, and as such the standardizing of generic and specific names will take time. The applied entomologist is not blameless in this respect, for he, too, has the habit of changing names; for example, the coccid, *Lecanium corni* Bouché, though long known as the 'peach scale' following its appellation the 'brown scale', is now termed the 'European fruit scale'!

Of the fifteen chapters, eleven deal with fruit pests arranged under their respective hosts, which are arranged alphabetically, and one chapter (xii) is devoted to a review of the pests of hops. Chapter xiii discusses beneficial and harmless insects, while the penultimate chapter deals with insecticides. The final chapter, entitled "Spraying Equipment and Methods", has been written by Mr. J. Turnbull, the Ministry of Agriculture's specialist on the subject.

A limited number of references conclude the note on each pest described, but the omission of references in the case of Chapter xiv requires to be rectified in a second edition. It is apparent both in the notes on control measures and more especially in the chapter on spraying equipment and methods that the book is written primarily for the fruit-grower rather than for the owner of smaller establishments. This is unfortunate, for the earlier works of Miss Ormerod and Prof. Theobald are examples worthy of assimilation, in that these authors never failed to appreciate the difficulties *both* of the owner of large plantations and of the amateur gardener.

It is strange to read the author's statement (p. 233) that the 'cauliflower' disease of strawberry is probably due to virus infection, for the work of Dr. Margaret Lacey indicates that a bacterial organism is concerned with this malformation.

Notwithstanding these several criticisms, Dr. Massee, who is recognized as the foremost pomological entomologist in Great Britain, has produced a work of outstanding merit which will long remain a classic. It will be welcomed by the fruit-growing community, the biologist, the student, and by all who are interested in fruit culture. The author has not sought to embellish his story with scientific jargon; the simplicity of phrase, though worthy of emulation, is rare; and Dr. Massee shines despite of it, thereby showing his eminence in the field of biology.

G. FOX-WILSON.

Experimental Optics

Introduction to Optics

By Dr. G. B. Deodhar. Pp. xii + 614 + 21 plates. (Allahabad: The Indian Press, Ltd., 1936.)

THE term 'Introduction' applied to a text-book on a branch of physics gives little idea of the standard and scope of the work. Those who are familiar with the customary method of teaching optics will understand what is implied in this case from the fact that the work is based upon the author's lectures delivered to degree students in the University of Allahabad. It is assumed that the reader is familiar with the elementary principles of physics, such as are taught to pupils during their last school year, or to students during the first year at a university. In Great Britain the work would be regarded as suitable for an ordinary degree course in optics but as falling short of the standard required in an honours course.

The author tells us that he is especially concerned in keeping the experimental side of the subject in the foreground and that the treatment is chiefly non-mathematical in character. The first six chapters are devoted to geometrical optics and the remaining thirteen chapters to physical optics. The book is large, consisting of some six hundred pages, and the syllabus of subjects is complete and adequate.

In the treatment of geometrical optics, the author adopts the Abbé sign convention, which chooses oppositely directed axial directions for the location of object and image. He thus falls in with a custom which is becoming more and more widely adopted. His convention with regard to angles is confusing, and is not necessary. He introduces the reader to the 'principal points' in a simple and interesting manner; but he ought to have elaborated the brief explanation of his points in this connexion. He ought also to have given a fuller account of telescopic systems.

Many practical questions on the investigation of lens systems are treated, and this is certain to be helpful to the student reader. In the treatment of interference, diffraction and polarization, the author keeps very closely to the methods of some well-known writers on the subject of physical optics, and makes use of familiar diagrams. He makes some improvement in the presentation of the formula for the resolving power of the microscope, but again errs by being too sparing in the discussion. The last few chapters are concerned with Bohr's theory of spectra, with colour, photometry and the other experiments.

A work of this kind must be judged to some extent on the basis of the purpose for which it is written, but some general criticisms arise in connexion with it. There are several well-known standard text-books on this subject, and a new one ought not merely to add to their number. It must either introduce new matter or present the old in a novel and better way. The present volume does not justify itself on these grounds; indeed the author accepts the old subjects and methods.

There is also the question as to what the nature of an introduction should be. Is it to introduce the reader to a very wide range of subjects, with the sacrifice of thorough study in the case of most of them, or should it treat a more limited range in which the principles are well illustrated and in which superficiality can be avoided? In this book, with its brief references to subjects not always well moulded into the general plan, the author creates the impression that he is afraid of leaving something out. It would appear that he favours the introduction to a wide range. But at the present time, when all branches of physics are becoming more and more bewildering in detail and extent, students require guidance to those parts of the subject where principles can be soundly grasped. Depth of study is an urgent need, and it is suggested that this book will be improved as an introduction to optics if the author will consider this point in modifying future editions.

Advanced Dynamics

Dynamics
Part 2. By A. S. Ramsey. Pp. xi+344. (Cambridge: At the University Press, 1937.) 15*s*.

THE publication in 1929 of Mr. Ramsey's excellent dynamics for the use of higher divisions in schools and for first-year students at universities has called forth many requests for similar treatment of the more advanced parts of the subject. The present volume has therefore been written as a continuation of the course so well laid out in the earlier book. It amplifies both the dynamics of the particle and of rigid bodies, and extends the discussion to three dimensions sufficiently far to meet the requirements of an honours degree. It also includes the use of generalized co-ordinates, motion under no forces and the motion of tops and gyrostats. The author has had the advantage of drawing freely from the late Dr. Besant's "Treatise on Dynamics" which was a model of conciseness and lucid exposition, and which, although revised by Mr. Ramsey some twenty years ago, is now out of print.

The plan of the book has been skilfully devised so that the inherent difficulties of the subject may be intelligently surmounted by the average student. There are twelve interesting chapters, abundantly illustrated by seventy fully worked-out examples, most of which are taken from recent examination papers. This is done to represent the kind of knowledge which is expected of present-day students, but it is apt to confine the subject-matter within somewhat artificial boundaries, especially if the syllabus to be covered is traditionally academic. This, however, is not the fault of any author who sets out to deal with a specific syllabus, and, whilst the content of the present volume is undoubtedly academic, the treatment is thoroughly fresh and stimulating. Practical topics, such as longitude, gyrostats, gyrostatic compasses, etc., are touched upon, though mainly from a theoretical point of view.

The book closes with an appendix on vectors and their applications, for the author does not wholly approve of the principle of establishing the fundamental equations of dynamics by vectorial methods, which he rightly regards as a modern fashion not designed to become permanent.

There is an abundant supply of examples for the use of the student, and each set is roughly divided into two groups, one of easier problems and the other of a more difficult character. The book will undoubtedly be of great value to all students who are training to become mathematical specialists.

F. G. W. B.

The Ancient Burial-Mounds of England

By L. V. Grinsell. Pp. xiii + 240 + 24 plates. (London: Methuen and Co., Ltd., 1936.) 12*s.* 6*d.* net.

Mr. Grinsell is an enthusiast about his subject; and although he does not profess to be a scientifically trained archæologist, if he fails to inspire the reader with his own enthusiasm, it will not be the fault of his excellent descriptions of the barrows of England. He includes all that the amateur will desire to know of the history of the study of barrows, of their types and chronology, of burial customs, of their folk-lore and of their local names. He describes the methods of study in field-work and by excavation. Finally, he gives a detailed topographical list of these monuments, of which the only criticism to be made is that it is more complete for the south of England than it is for the north. The illustrations are good, though small. Brief bibliographies are given for the benefit of those who wish to carry their studies further.

Handbuch der biologischen Arbeitsmethoden

Herausgegeben von Prof. Dr. Emil Abderhalden. Lief. 460. Abt. V: Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus, Teil 10, Heft 6. Allgemeine und vergleichende Physiologie. Eine Verstärkeranordnung zur Registrierung gehirnelektrischer Spannungen, von Rudolf Ottenthal; Neue kataphoretische Verfahren, von Hugo Theorell; Lichtelektrische Zellen und ihre Anwendung für wissenschaftliche Messungen, von Marie Wreschner. Pp. 1075–1234. (Berlin und Wien: Urban und Schwarzenberg, 1936.) 9 gold marks.

The first paper describes an amplifier designed to work an oscillograph for recording electrical changes in the intact brain. The arrangement consists of a three-stage resistance capacity amplifier containing two pentode valves followed by a triode. The values of the various condensers and resistances are chosen to give a long time-constant, and the author claims an undistorted amplification of 70,500, constant over a frequency range of 10–500 cycles per second.

An interesting application is described in which two amplifiers are simultaneously led off from the same cranial electrodes, thereby giving two oscillograms on the same photographic paper. One instrument responds normally over the complete frequency range, while the other, by means of large capacity condensers arranged in parallel with the anode resistances of the first two stages, amplifies efficiently only at frequencies of 1–10 cycles per second. From the two simultaneous oscillograms an approximate curve analysis is obtained.

The second paper describes an improved type of kataphoresis apparatus in which it is possible to maintain the solution at a constant pH value. Several examples of its application for the investigation of biochemical material are quoted, such as references to work on flavin, Warburg's respiratory co-enzyme, cytochrome *c*, blood serum, and the anti-pernicious anæmia principle of liver.

In a larger type of apparatus suitable for the purification of various substances, the cell has a greater cross-sectional area, and parchment paper diaphragms are employed to separate the intermediate buffer solutions.

The third paper commences with a fairly comprehensive survey of present-day knowledge of photoelectric phenomena, and includes a number of useful references. This section is followed by detailed descriptions of different types of photo-electric cells and their characteristics. The remainder of the paper is devoted to descriptions of numerous applications including microphotometry, spectrophotometry, colorimetry, nephelometry, pyrometry and polarimetry.

Die mathematischen Hilfsmittel des Physikers:

Von Prof. Dr. Erwin Madelung. Unter Mitarbeit von Dr. Karl Boehle und Dr. Siegfried Flügge. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, herausgegeben von R. Courant, Band 4.) Dritte vermehrte und verbesserte Auflage. Pp. xiii + 381. (Berlin: Julius Springer, 1936.) 28.80 gold marks.

This book falls into two distinct parts: mathematics and physics. The third edition differs from the second (published about twelve years ago) in respect of a more systematic handling of the subjects, the introduction of much new matter, including a chapter on group theory, and a complete rewriting of the chapter on quantum theory. The author's object is to provide for physicists a précis of those parts of mathematics which shall be of direct use, and which could only be otherwise obtained by consulting a large variety of text-books. In the second part of the book the equations of mathematical physics are formulated.

The result is excellent as a piece of clever condensation, but one cannot help feeling that to make any adequate use of matter in such concise form—practically no proofs or illustrations are given—the reader will have to consult the text-book after all. For the mathematician or physicist, however, the work affords admirable and useful summaries in their respective subjects.

Faithful Rebels:

a Study in Jewish Speculative Thought. By Dr. Israel Levine. Pp. viii + 146. (London: The Soncino Press, 1936.) 6*s.* net.

In this work Dr. Israel Levine, the head of the Philosophy Department, University College, Exeter, discusses the outstanding contributions to philosophy by Jewish thinkers from biblical times down to the present day. In the oldest writings of Hebrew culture as represented by the Book of Job and Ecclesiastes and the works of Philo and Maimonides, little philosophy is to be found, and it is not until the middle of the seventeenth century that Jewish philosophy begins with Spinoza, while in the nineteenth and present centuries Marx represents economic science and Bergson metaphysics. Dr. Levine comes to the conclusion that science and philosophy are not really native to the Hebrew genius, but require for their development the stimulus of alien culture and the raw material of alien contact.

The Natural Philosophy of Paintings

By F. Ian G. Rawlins

IN his inaugural lecture in 1936 as Tait professor of natural philosophy in the University of Edinburgh, Prof. Max Born referred to an essential difference between science and art. Mathematical and physical theories deserve well if they meet the intellectual needs of their period, whereas the creations of great artists are for all time. It might appear from this that mankind is obliged to reckon with continuous change in his scientific concepts, and can hope to find rest unto his soul only in the static nature of art. However this may be, it is no purpose of the present article to insist upon such a distinction, but on the contrary, rather to inquire into the conditions which exist (or may exist) tending to bring the worker in the exact sciences into contact with the world of art and its problems.

One such opening is obvious enough—the task of applied physics and chemistry in assisting the curator in the conservation of paintings, both by a knowledge of materials as such and by devising methods of improving the environment in which objects of supreme value are housed. Progress along these directions is not difficult to trace. There are laboratories specially equipped for such studies at the Fogg Art Museum in the United States, at the Louvre in Paris, the National Museum in Lisbon, and three in London—at the British Museum, the Courtauld Institute (Norman Wilkinson Foundation) and the National Gallery. Much has been learnt at all these places; but it is clear that basic questions relating to the behaviour of paintings in certain circumstances remain unanswered, and that a fair amount of the data so far collected is little more than empirical.

In Great Britain, co-operation with specialist institutions under the Department of Scientific and Industrial Research has proved both interesting and effective. The experiments needed are so many-sided that no one laboratory could expect to cope with more than a fraction of them.

There is another way in which physics and chemistry may help. This is in the prosecution of systematic studies relating to the technique of the old masters; the search for forgeries and their possible establishment are notoriously difficult tasks, but if and when such results are possible, it is not infrequently as a by-product of the careful investigation of painters' methods in general. There is much to be said for the regular use of X-ray analysis to assist the student of art history in his researches, and as a check upon the conclusions which he may reach on stylistic grounds. It is no part of scientific method to attempt to do what only 'an eye for a picture' can, in the end, accomplish; nevertheless, investigators will not refuse objective evidence when it can be forthcoming. Fortunately, favourable cases do arise.

Yet another possibility can be visualized, difficult as it is. In much the same way as physics and philosophy are to some extent conterminous, so a detailed study of art history leads naturally to the necessity of exploring the mind of the artist, and consequently the outlook of his time. Thus art history and psychology tend to share common ground. Doubtless, a large number of pictures were commissioned and executed according to rigid conditions prevailing in the ideas of the period, yet here and there examples appear which seem to indicate that the work in question was brought into being in the subconscious mind of the artist and is thus a document of the deepest significance. It is a far cry to the day when anything of this nature might conceivably be demonstrable experimentally; what is important at the moment is the infiltration of scientific method into the attempt to effect a closer synthesis between our appreciation of works of art as they are, and the mental and cultural background which produced them. A work of art is an organized whole, possessing shape as well as tone; above all, it is no mere accident, and in its fashioning the artist may be presumed to have given of his best. These conditions approximate to the law of *prägnanz* in the psychology of Gestalt. It may be here that, in the last resort, a natural philosophy of paintings may be found.

The immediate problem is the application of scientific principles to paintings in the matter of conservation, restoration, environment and in the systematic study of technique. A major consideration is that of safety. No risks can be entertained for a moment, and therefore much may have to be learnt upon models, or by the artificial reproduction of conditions. The essential characteristic of a painting—mural or panel—is its stratified structure. In order, there are (*a*) the support or carrier, for example, plaster or wood, (*b*) the ground, (*c*) the paint film, (*d*) the surface or varnish film. According to the varying methods of different schools, modifications of this sequence may arise; but it represents the normal state of affairs, and the one with which the scientific investigator usually has to deal. Clearly, of the four, the paint film is of the greatest interest to the beholder, for it is in fact 'the picture', as generally understood.

From this arrangement the scope of physical and chemical investigations can be gauged. First comes the need for accurate knowledge of the physico-chemical properties of plaster and wood. Secondly, the ground is perhaps composed of 'gesso', a water paint containing lime as its main constituent, and often the seat of an involved system of cracks, which may influence the layer above. Thirdly, the paint film is a most complicated phase, comprising pigment plus binding medium. Fourthly, the varnish film is not an exact chemical entity, and its properties change considerably with time. All these layers react to some extent upon one another, more especially with regard to relative flexibility. Chemical reactions in the paint film sometimes generate fissures akin to geological phenomena on a minute scale.

In general, the paint film may be constructed in a variety of ways. The pigments may be embedded in a previously prepared surface, or they may be powdered with a suitable medium (as in ordinary oil painting), or again they may be applied to a dry surface and afterwards fixed by some kind of spraying.

As in other branches of science, physical methods may be preferable to chemical ones in that no sampling or removal of minute fragments of material is required. When, however, it is necessary to know for certain the composition of a pigment, then it has long been the custom to detach a microscopic amount from some inconspicuous part of a picture (under the rabbet of the frame for example) and to subject it to chemical or spectroscopic analysis. In very favourable cases, observation with a polarizing microscope will give a clue to the nature of a pigment *in situ*, by reference to crystallographic properties, colour and index of refraction. An extremely illuminating method—when conditions allow—is to use a micro-borer, and so to obtain, in the form of a minute cylinder, samples of all the different strata. Microscopical examination of the core, at a magnification of about one hundred diameters, reveals the constituents clearly.

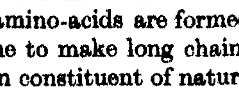
The possibilities of X-ray work are considerable, and at several institutions systematic use is being made of them. The whole process, so far as pictures are concerned, depends for its success upon the particular pigments and technique in question. It is by no means of universal application. Exceedingly thin films of paint, such as those sometimes used by the Venetians, are frequently too transparent to offer any appreciable resistance, except perhaps to the very softest radiation. However, areas containing much lead or mercury, in the neighbourhood of compounds like the lakes, composed of elements of low atomic weight, make excellent subjects, and a wealth of detail is often revealed. Sometimes the experienced eye can perceive the presence of an outline under the visible paint layer: X-ray photographs supply the objective proof. The uses to which such photographs can be put are several. If it is proposed to remove over-paint, the extent of the original picture left can be determined before any action is taken. Again, a previous version of a composition may be discovered or, as has happened lately, the work of two artists can be distinguished.

It remains now to discuss some external factors which influence the condition of paintings, and to which it is possible to apply scientific methods. For many years there has been an increasing movement for the abolition of the glasses from pictures in the national collections. From the students' point of view such a course would have everything to recommend it. In practice, however, difficulties are encountered. Experiments have shown that the surface of a canvas, if unglazed, is usually cooler than the air of the gallery, and consequently condensation of moisture sets in, forming a thin wet film over the varnish. Dust and smoke particles settle on this film, and create in time a dull, dirty layer, easily removable in some cases, but by no means in all without risk to the varnish. The cure, theoretically, is a complete air-conditioning and filtering plant. Observations in the National Gallery have demonstrated that for every pound of carbonaceous material per million cubic yards of atmosphere in the immediate neighbourhood of the gallery, 0.7 lb. is present within the building. This is an average figure for the interior as a whole, and seems to represent a fairly constant quantity. In any event, there is a strong argument for air-conditioning in museums and galleries if objects of art are to be seen at their best.

Perhaps the greatest need of all, as indicated already, is a closer understanding between the outlook of the student of art history and that of the scientific investigator. Co-operation for practical ends like conservation and protection there must obviously be. But the ultimate aim is a more intimate fusion of the two ways of thinking, such as would lead to the appreciation of a work of art as an object of the profoundest symbolism. Some of the great masters were intellectuals of a high order, as well as supreme craftsmen. To know them better is to broaden our concept of natural philosophy.

Agricultural Products as Raw Materials for Industry*

TO what extent is agriculture likely in the future to supply the raw materials for industry in addition to food and textiles, her main customers to-day? The answer to this question involves a forecast of both demand and supply: whether the nature of the demands will alter, and whether in meeting them materials or manufacturing methods will change fundamentally. Biochemistry and biotechnology are of great significance for the future of industry, but their value will be judged largely by their power to save expenditure of material and energy. For more than a century, organic chemists have been investigating the atomic structure of the products of organic life, and the new weapons, X-rays and electron diffraction, have been of great service.

Although we still know very little of the mechanism used by Nature in synthesizing these complex substances, it is clear that they are built up on comparatively simple models. Starch, cellulose, hemicellulose, and the pectins appear to be built up from hexose units like glucose, though possibly the primary unit is a triose, like glycerin, containing three carbon atoms, since the units $C_6 - C_3$ and $C_6 - C_3 - C_6$ occur frequently in plant products and the transformation $2C_3 = C_6$ presents no difficulty to Nature. Vegetable oils, fats and waxes are built up of long chains from units of six carbon atoms. Essential oils, resin and rubber are built up from the unit C_5H_8 with a branched carbon skeleton  , which may be regarded as their parent substance; and from the same unit the plant can construct the terpenes and diterpenes, which have ring structures. The resins are more complex, containing twenty or more atoms, but of similar type.

Proteins are derived from the union of ammonia with carbon-chain units; amino-acids are formed, and their molecules combine to make long chains, like fibroin, the chief protein constituent of natural silk. Long chains similar to these, but folded into rings, are the structural units of the vegetable proteins found in many seeds and tubers. Many alkaloids also can be regarded as built up in the plant through the medium of amino-acids.

The mode of formation of chlorophyll—the key substance in the living world—is obscure; it presents us with the old problem of the hen and the egg, for chlorophyll is essential for the synthesis of carbohydrates, but carbohydrates are required to make chlorophyll. Many natural flavouring substances, for example, eugenol, are built up upon a $C_6 - C_3$ skeleton, and this group may be doubled to give constituents of many resins, or with the addition of a C_6 group to give the catechins, found in the tannins, and in anthocyanins, the colouring matter of many plants.

Although Nature synthesizes her complex products from simple units with an ease and certainty that tantalizes the chemist, by elucidating their structure, he has succeeded in synthesizing many of them artificially. Nevertheless Nature has proved to be a cheaper producer than the factory, and is likely to remain so. Many so-called synthetic substances, for example, camphor and ionone (the perfume of violets), are made from vegetable products in which the carbon skeleton has already been formed by the plant, and they are thus the result of chemical processing.

Of greater significance from the point of view of displacement of plant products, is the use of cracked oil gas and natural gas in the United States as starting-points for the manufacture of organic chemicals, and also their production from water gas by catalytic processes, and from calcium carbide made in the electric furnace. Here there is direct competition with the products of the fermentation industry and of wood distillation. Synthetic 'rubber' made from cracked oil gas is another example of this competition. On the other hand, the more detailed knowledge of plant products has led to great developments in their extraction and utilization, for example, the process of fat-hardening, the conversion of molasses into alcohol, glycerin, acetone and other solvents, and the production of furfural from cereal wastes for use as a solvent or as a constituent of plastics. Research has also opened up completely new fields, such as the cellulose products and synthetic resins or plastics, in which agricultural materials like casein, glycerin, soya bean are finding fresh outlets. The possibilities of plastics are great; at present they are handicapped by high cost, moulding powder costing £75 to £100 a ton, and the great pressures required for moulding thermoplastics are expensive to apply to large articles.

The present percentage utilization of agricultural produce in the world is, on a value basis, roughly: food 86–88, textiles 9–8, and other industries 5–4, so that the consumption by industry is at most only 12–15 per cent of the total production, and of this textiles account for about two thirds. On this basis it is estimated that the value of farm, field and forest products used in industry now amounts to about one half that of mineral products, that is, to one third of the whole value of industrial raw materials.

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* Based upon the Mather Lecture given by Sir Harold Hartley to the Textile Institute on June 11.

The extent to which agricultural materials may replace minerals and metals will depend on physical properties and cost. Some plastics are suitable for replacing metals; the use of synthetic resins as adhesives, and the improvements in the manufacture of laminated wood already make it a successful rival to metal in many fields, for the new products possess such advantages as absence of fatigue, high ratio of strength to weight, and resistance to corrosion, whilst the defects of wood due to local weakness are eliminated by the laminated structure. Rubber is also supplanting metal in fields where its elasticity, freedom from abrasion, and value in reducing noise are required. Laminated wood is finding many applications in building construction owing to its strength, lightness and low cost; and the substitution of nitrocellulose and synthetic resins for the older natural resins, and that of the new solvents and plasticizers for the older and cruder materials of the forest-produced type, all in the main involve the use of processed agricultural products. The cost of producing fermentation alcohol from molasses, at *2d.* a gallon, is estimated at *9d.* a gallon; and from maize at *2s.* a bushel, at *1s. 3d.* a gallon; but the cost of petrol at the refinery without tax is *3d.* a gallon; its use to-day as motor fuel is only justifiable on strategic grounds, but when petroleum supplies begin to contract, alcohol will be in a better competitive position. There has been a very great development in the use of new packing materials, made of wood, textiles, cellulose, Cellophane, etc., but mineral oils have been replacing vegetable oils for lubrication, although the total consumption of the latter has not declined.

In the United States, the Farm Chemurgic Council is working strenuously to promote the use of American farm products; and the Department of Agriculture, with its numerous associations, is admirably equipped for research and development work in this connexion; as also in the wider field of finding new crops like soya bean, tung oil and southern pine, to replace products now imported. Success will depend on the co-operation of industry in providing factories for processing the raw materials and the research necessary to find new and cheaper methods of using them. The utilization of farm wastes and by-products is being investigated; already cull citrus fruits in California are being processed for producing citric acid, citrus oils and pectin, but an economic method for using waste farm cellulose for paper, strawboard, insulating material or packing has yet to be found. Within the last decade, the soya bean has become a major crop in the United States. One ton of it yields about 250 lb. of oil and 1,600 lb. of meal. The oil is used in edible products and in making paints, enamels, varnishes, linoleum, soap, glycerin and printing inks. The meal is mainly used in foodstuffs, but a good deal goes to the manufacture of protein glues, paper sizes, washable wall-papers, and protein plastics. Mr. Henry Ford has been one of the pioneers of this new crop. It is estimated that the annual output of a million Ford cars involves the consumption of the following quantities of farm produce: cotton 89 million lb., maize 500,000 bushels, linseed oil 2·4 million lb., molasses 2·5 million gals., wool 3·2 million lb., leather 1·5 million sq. ft., hogs 20,000 (to supply lard for lubricants, oleic acid and bristles for brushes), mohair 350,000 lb., and soya bean oil 2 million lb. (for making enamel).

The discovery of new uses for established crops is well exemplified by research on cotton, which has disclosed the effect of fibre fineness on the strength of cotton yarns. Extensive breeding and selection are showing how to improve this characteristic in American cottons. Strength and durability are needed in cotton used for making bags and bagging, and a fresh outlet here is the development of duplex open and close-mesh fabric bags for packing fruits and vegetables, millions of which have been sold. The use of cotton fabric for reinforcing tarred roads has been investigated, and with seeming success. After the road bed has been levelled and primed with tar, the cotton fabric is laid down and then covered with alternate dressings of asphalt, road metal and chips, which are consolidated with a heavy roller. Strenuous efforts are being made to find new uses for maize. In the Middle West about 7 per cent of the maize crop is processed for industrial purposes, the main products being starch, dextrin, corn syrup, dextrine, corn oil and cake. Finally, sugar or starch derived from second-grade maize or other grain, sugar-beet, and molasses is being converted into industrial solvents.

The energy and skill with which all these investigations are being pursued is beyond praise. The answer to the question posed in the first sentence cannot be definite. The use of carbon compounds is certainly being extended, and perhaps we are approaching a cellulose-plastic age. But the chemist cannot vie with Nature in the cheap production of complex organic molecules; and the future lies in closer association between them. Such a development of the use of agricultural products would be most fortunate in view of the gradual exhaustion of our capital assets, coal and oil.

New Zealand Fish Oils

By F. B. Shorland

ALTHOUGH the fish life of New Zealand waters offers many interesting and unusual features, the study of the fish oils has, until quite recently, been practically neglected. The earlier work included an analysis of sting-ray liver oil by Donovan[1] and more extensive researches on the food values of New Zealand fish initiated by Malcolm in 1920. During the course of these investigations the oil content of the flesh from various fish was examined[2,3] and the fats of red cod (*Physiculus bachus*) in relation to its food were studied. The fat content was less in winter than in summer, indicating a depletion of reserves during the scanty winter feeding[4]. Although tarakihi (*Dactylopagrus macropterus*) flesh was found[5] to contain appreciable amounts of vitamin A, none could be detected either in the ether extract of this flesh or in the ether extracts from the flesh and liver of red cod[6].

Denz and Shorland[7] discovered in 1934 that the larger edible fish of Cook Strait, including ling, English hake and in particular groper and bass, yielded liver oils of much higher vitamin A potency than had generally been recorded in the case of North Sea fish. In contrast with the fish which had hitherto been examined by other investigators, the vitamin A content of ling liver was not found to exhibit any marked seasonal variation[8].

Lately, New Zealand freshwater eels, of which there are two species, *Anguilla aucklandii* and *A. australis*, have received considerable attention. It was found that the body oil (comprising so much as 20 per cent of the total weight of the fish) had a vitamin A potency approaching that of cod liver oil, while the traces of oil in the liver were extremely rich in this vitamin[7,8]. McIntosh and Shorland[9] established a general similarity between the composition of the component fatty acids of *A. aucklandii* and that of typical freshwater fats of the northern hemisphere analysed by Lovern[10], thus confirming the difference between the marine and freshwater types of fat. An examination of the C_{18} unsaturated acids showed the presence of oleic and stearidonic acids. Neither linoleic nor linolenic acid could, however, be detected[9]. Edisbury, Lovern and Morton[11] showed that the ratio of non-liver vitamin A to liver vitamin A of *A. aucklandii* tended to increase with age, while the increased vitamin content of the body oil in the older fish was correlated with the oil content of the tissue.

In many instances, fish oils of high vitamin A potency are also good sources of vitamin D. Cunningham[12] reported vitamin D values of 2,250 and 500 for groper and ling liver oils respectively, as compared with 100 international units per gram for good cod liver oil. Skate (*Raja nasuta*) liver oil and the body oil of freshwater eel gave, respectively, the lower values of 15 and 47.

The deep-sea fishing industry of Cook Strait, which provides the commercial liver oils, is rather

CHARACTERISTICS OF SOME NEW ZEALAND AND OTHER FISH LIVER OILS

	Species	Body weight	Liver weight	% Oil	Iodine value	Saponification value	% Unsap. matter	% Vitamin A $\frac{(E^{1\%}_{1cm}\ 328\ m\mu)}{10}$
New Zealand	Ling (*Genypterus blacodes*)	20 lb.	1 lb. 7 oz.	35	137–158	183–189	2–4	0·6–0·7 (usually)
	English hake (*Merluccius gayi*)	18 lb.	1 lb. 6 oz.	35	132–143	185–187	2–4	0·3–0·8
	Groper (*Polyprion oxygeneios*)	10 lb.	6 oz.	5–10 (usually)	82–122	176–197	3–15	0·5–5·0
	Bass (*Polyprion americanus*)	somewhat heavier than groper	8 oz.	5–10	78–131	175–191	4–16	1·0–4·5
North Sea	Cod* (*Gadus morrhua*)	17 lb.	14 oz.	60–70	140–180	180–190	1	0·01–0·05
	Halibut* (*Hippoglossus vulgaris*)	60 lb.	1 lb.	20	111–171	150–175	8–22	0·2–10 (usually 1–1·5)
	13 Hake (*Merluccius merluccius*)	—	—	—	149–150	184–186	0·9–1·7	similar to cod liver oil
Chilean	14 (*Merluccius gayi*)	—	—	—	185	176	2·0	similar to cod liver oil
	14 *Genypterus blacodes* and *G. chilensis*	—	—	—	169	188	0·2	somewhat stronger than cod liver oil.

* Typical values from the results of various investigators.

limited on account of the small area of the banks. About 8,000 cwt. of groper and 2,000–4,000 cwt. of ling are caught annually, together with smaller quantities of English hake and bass. In other large centres such as Auckland, smaller fish, including snapper, tarakihi and flounders, predominate, and although some of these yield a small proportion of vitamin-rich oil the livers invariably weigh less than 2 oz.

Cook Strait elasmobranch liver oils are not rich in vitamin A. Skate (*Raja nasuta*) liver oil for example, is less potent than cod liver oil. Oils from individual livers are sometimes exceptionally potent. That from a bass contained 10 per cent vitamin A, while a swordfish from North Auckland yielded a liver oil with some 14 per cent of this vitamin.

An examination of the properties of the liver oils given in the accompanying table for the same or similar species inhabiting different waters suggests that the composition and vitamin A content are sometimes determined more by environment than by biological considerations of species.

Observations on the properties of groper liver oils, which will be published in detail elsewhere, show that the winter oils, especially during July and August, approach the upper limit given in the table as regards vitamin A content, iodine value, and percentage of unsaponifiable matter. During the intensive feeding of October and November, these values approach the lower limit and the livers become softer owing to the infiltration of fat, which in some instances increases the oil content to 20 per cent of the liver weight. The oil from *Sardinia neopilcharda*, a source of food at this time, gave no reaction for vitamin A. Seasonal changes in the properties of groper liver oils thus appear to be associated with alternate intensive feeding and relative starvation. The North Sea halibut affords an interesting contrast with groper in that the potency of the liver oil is lowest in winter but rises to a maximum during the seasonal increase of diatomaceous food in the spring[14]. Winter groper liver oil is exceptional in containing as much as 20 per cent phosphatide. An analysis of the component fatty acids of these oils is being made under the direction of Prof. T. P. Hilditch, of the University of Liverpool. Examination of other fat depots including the roe, head and stomach failed to reveal the presence of vitamin A except in the stomach oil.

Further work on ling liver oil at present in progress substantiates the lack of marked seasonal variation of vitamin A content or in yield of oil as determined by ether extraction. Of the total fat present in the fish, more than 96 per cent is concentrated in the liver, and during spawning less than 0·5 per cent of this fat is transferred to the roe. The ether extract from the ova gave no Carr-Price test, while that from the stomach showed a value of 800. Lack of seasonal variation in the vitamin A content during spawning seems to be explained by the fact that the production of ova requires an insignificant drain on the liver oil. Both cod and halibut appear to derive their vitamin-rich liver oils from food relatively deficient in this vitamin by a process of intensive storage[15,16]. In these circumstances, it is not surprising to find that the livers from the older fish contain a higher concentration of vitamin A[16,17]. In the case of Cook Strait ling, however, the chief food is whiptail[8,18], which is rich in vitamin A (a specimen taken from a ling stomach, for example, yielded an oil giving a Carr-Price value of 75), so that relatively little storage is necessary to produce a vitamin-rich liver. In confirmation of this observation, the larger livers from the older fish have not been found to yield a more potent oil than the smaller livers.

Ling liver oil is distinguished from typical liver oils of the North Sea by the higher content of C_{18} unsaturated acids (35–40 per cent as compared with 27–30 per cent) and the low proportions of palmitoleic acid (7–10 per cent as compared with 15–18 per cent). The ether extract from the roe contains about 56 per cent phosphatide. As in the case of animal fats, the phosphatide fraction is richer in C_{20} and C_{22} highly unsaturated acids than the glyceride fraction. The relative proportions of C_{20} , C_{22} acids in the liver, viscera, roe glyceride and roe phosphatide may be given approximately as 35, 45, 40 and 50 per cent respectively.

I wish to record my sincere appreciation and thanks to the directors of the British Drug Houses, Ltd., London, for generously placing their analytical laboratories at my disposal. Thanks are also due to Mr. T. T. Cocking of that laboratory for valuable advice, to Prof. T. P. Hilditch for his continued interest and to the Department of Scientific and Industrial Research, New Zealand, for a scholarship.

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Obituary Notices

Dr. J. W. Capstick

JOHN WALTON CAPSTICK, who took a prominent part in the work of the Cavendish Laboratory from 1891 to 1898, and in the administration of Trinity College from 1895 until 1910, was born at Lancaster on August 31, 1858, and educated at the 'Friends School' in that town. In 1880 he went to Owens College, Manchester, which was then a part of Victoria University; he won at Owens the senior Dalton mathematical scholarship in 1882 and took first class honours in mathematics at the examination for the B.A. degree at the University of London in 1883. He then took a teaching post in the University of Dundee, saved some money, and entered Trinity College, Cambridge, as a sub-sizar in 1888. He was elected to a sizarship in 1889 and to a scholarship in 1890. He took a first class in Part 1 of the Natural Sciences Tripos in 1890, and one in Part II, with distinction in both physics and chemistry, in 1891.

In that year, Capstick began original research at the Cavendish Laboratory on the values of the ratio of the specific heats in gaseous compounds of various types. He was a very good experimenter, a skilful manipulator, and very persevering, and was never content until he always got consistent results. These researches, which gave valuable additions to our knowledge, were published in two papers in the *Philosophical Transactions of the Royal Society* for 1894 and 1895. They had much to do with his election to the Coutts Trotter scholarship in 1892 and to a Trinity fellowship in 1893. His next research was on the relation between the 'cathode fall of potential' in compound gases of different types; he was, however, unable to get consistent results; we know now that a mere trace of impurity produces a great effect on the cathode fall, and to remove these traces requires methods of producing high vacua which had not been invented at that time.

In 1895 Capstick was appointed lecturer in natural sciences in Trinity College in succession to Glazebrook, who had been appointed senior bursar; he gave lectures at the laboratory to candidates for the Natural Sciences Tripos, and in 1898 he took over the lectures for medical students which Glazebrook had given for many years. He was appointed to the very arduous post of junior bursar at Trinity College in 1910, and though he still continued to give some lectures at the Laboratory he had no time for research. He was a very successful junior bursar; he liked the work and did it very well.

Capstick had an exceptionally wide range of interests and activities. He took an interest in motoring from its very early stages, and kept in touch with its development. Thus, he was one of the first to drive a motor-tricycle, then he tried a steam car; he must have tried about half a dozen types of cars in his time and was always convinced that the new one was much better than the last. He turned his skill as a driver to good purpose during the Great War; he volunteered for the Red Cross, and for a year drove a motor ambulance for the French Army. He was always anxious to help other people. When at the very beginning of the War the Cloisters in Neviles Court in Trinity College were used for a military hospital, he visited the hospital regularly and often after talking to a patient he would take his photograph and give him copies to send home to his friends. He was an expert photographer, but it required more than photography to think of doing a deed like this.

Capstick had a great love for music, and it was one of the chief interests of his life. For many years he took the leading part in teaching acoustics to the candidates for musical degrees. He was not merely a good lecturer on music but was also a good musician and a good player of that exceedingly difficult instrument the French horn. For years a regular attendant and valued member of the orchestra of the Cambridge University Musical Society.

Capstick's health broke down suddenly about five years ago, and for the rest of his days he had to live the life of an invalid; he died at his house in Cambridge on April 27. His old friends cherish the memory of the help, the kindness and the good companionship they received from him. J. J. T.

Prof. S. Pennington

PROF. SYDNEY PENNINGTON, who died at Newport, Salop, on July 19, was born in 1869 and received his early education at Giggleswick School under the headmastership of the Rev. George Style. After leaving school in 1888 he had four years experience of practical agriculture in Shropshire. The next three years he spent in study at the Royal (Dick) Veterinary College, Edinburgh, and the Royal Veterinary College, London, obtaining the diploma of M.R.C.V.S. in 1895. After this he again returned to farming until 1902, when he decided to enter upon another course of study. Consequently, at an age considerably beyond that at which men now commence their academic career, and with a very thorough knowledge of farming practice, he proceeded to the University of Edinburgh, whence he graduated with the degree of B.Sc. in Agriculture in 1905. His first teaching appointment was as lecturer in veterinary hygiene in the School of Agriculture at Ghizeh in Egypt. In 1908 he returned home, and was in that year appointed lecturer in agriculture at what was then University College, Reading. In recognition of his work he was elected the first professor of agriculture at Reading in 1920. After twenty-five years service to the University of Reading, he retired in 1933, and was accorded the title of emeritus professor.

Pennington will be remembered best as a great teacher by the many agricultural students who passed through his classes. He was himself so full of enthusiasm for his subject that he readily infected others and especially young minds. This was even more marked in his farm classes, where he drew so largely from his personal experiences. He had the secret of making his students feel they were listening to one who spoke from living contact with a living world. In addition to his teaching duties, Prof. Pennington had charge of the University Farm. When he commenced his work at Reading in 1908 he set himself the task of grading up a herd of dairy shorthorn cattle that would be eligible for registration in Coates' herd book, and at the same time of establishing a herd of cows on the University Farm free from tuberculosis and of good milking type. This he accomplished several years before his retirement, and the herd remains as a record of achievement on the present University Farm. The herd of dairy shorthorns at the National Institute for Research in Dairying was founded largely on cattle of Pennington's breeding.

Though neither an orator nor debater, Prof. Pennington spoke with a sincerity of conviction and a directness of purpose that commanded attention. He loved what was best in literature and art, and gathered together a surprising amount of knowledge and information on many and varied subjects. He was absolutely devoid of pretentiousness or seeking after effect. Pennington carried into everyday life a dignity of thought and conduct that unconsciously raised the tone of those about him.

J. S. L. Waldie.

Count Robert de Montessus de Ballore

Robert Fernand Bernard de Montessus de Ballore, whose death occurred towards the end of 1936, was born at Lyons on May 20, 1870. He belonged to one of the oldest families of Burgundy. His mother was a great-granddaughter of Philibert de Commerson, the botanist of the Bougainville expedition, his uncle Ferdinand de Montessus was known as an ornithologist, and his elder brother Fernand was a distinguished seismologist who founded an observatory at Santiago in Chile. For a time Robert de Montessus contemplated a military career, but in his late twenties he made up his mind that such a life was incompatible with a streak of independence in his character, and he began to study mathematics at the Sorbonne. In 1903, while still preparing a dissertation for his doctorate, he was invited to Lille by his friend Robert d'Adhémar, himself a distinguished mathematician, and there he was appointed professor of general mathematics in the Faculty of Science.

Robert de Montessus worked in many fields. Algebra owes to him a fundamental simplification in the use of Sturm's theorem, based on the method of successive approximations; his process is one for evaluating, to an arbitrary degree of accuracy, the real roots of numerical equations, transcendental as well as algebraic. The theory of elliptic functions attracted his attention, and he was stimulated by Halphen's pioneering work to obtain beautiful theorems on the representation, the singularities, and the classification, of algebraic skew curves; he studied carefully the twisted quartic of the first kind, that is, the curve of intersection of two quadrics, showing in detail as Halphen had shown in general terms that the current co-ordinates on this curve are expressible as elliptic functions of a single parameter.

In an important memoir on algebraic continued fractions, which was crowned by the Academy of Sciences, de Montessus presented a body of results constituting great advances in this difficult theory. Starting from a certain fraction which is convergent throughout the whole plane, except possibly on the rectilinear segment joining two points if the function represented by the fraction has two singularities, he deduced that analytic continuation by means of a continued fraction is not impeded by poles, or by algebraic or logarithmic singularities.

In his later years, de Montessus devoted much attention to the theory of probability, which he proposed to found on Bernoulli's theorem, regarded as an experimental fact. He tried also to find a satisfactory theory of correlation which should be applicable when the number of observations is small, and he developed some ingenious ideas on weighted probabilities.

About twenty years ago, de Montessus undertook the publication of the "Index Generalis", an annual reference work now well known throughout the scientific world and of inestimable value to every investigator. It is hard to conjecture the number of practical difficulties which de Montessus had to overcome in organizing this immense mass of data on the universities and learned societies of the world; the scientific qualities of which he had given evidence elsewhere came to his aid here.

In 1931, during a mission to Central Europe on behalf of the French Government, de Montessus gave courses of lectures on various branches of mathematics in Warsaw, Cracow, Lwow, Budapest, Vienna and other universities.

Robert de Montessus, has left the memory of a modest and conscientious scholar, an upright man, and a firm friend.

Henri Villat.

We are indebted to Mr. E. Mather for the information that the early training of his father, Prof. Mather, was that of an engineer, not that of a carpenter as stated in the obituary notice in Nature of July 17. Prof. Mather came from a family of engineers. We also learn that, during the Great War, Prof. Mather devoted much time to the invention and development of a device for giving warning of the approach of enemy aircraft.

We regret to announce the following deaths:

Prof. P. E. Brown, head of the Department of Agronomy in the Iowa State College, known for his work in soil science, on July 8, aged fifty-one years.

Lieut.-Colonel E. G. Ffrench, known for his researches in tropical medicine, especially dermatology, on July 25.

Prof. D. M. Lewis, emeritus professor of physics in the University College of Wales, Aberystwyth, on July 28, aged eighty-five years.

Prof. J. Wilhelm Michaelsen, head of the Department of Natural History in the Hamburg Museum an authority on the Oligochaeta, on February 18, aged seventy-six years.

News and Views

Prof. R. A. Sampson, F.R.S.

The retirement of Prof. R. A. Sampson from the position of Astronomer Royal for Scotland has been recently announced, and will shortly take effect. He has held this office, which is associated with the professorship of astronomy in the University of Edinburgh, since 1910 when he succeeded Sir Frank Dyson on the appointment of the latter as Astronomer Royal at Greenwich. Prof. Sampson's career has been long, varied and distinguished. His earlier years were spent in posts mainly mathematical, and it was only comparatively late in life that he was able to devote all his time, during the twenty-seven years at Edinburgh, to the pursuit of astronomy. But much of his astronomical work had already been done in the earlier period. Happily, this is not the occasion —may it be long distant—when it is necessary to give biographical details or to assess the value of scientific achievements. But it is interesting to recall that Prof. Sampson was the first product of the Isaac Newton studentships (1891–3), then lately founded by Mr. F. McClean, for he gained this prize a year after his election to a fellowship at St. John's College, Cambridge, where his mathematical career had been eminently successful. Between 1893 and 1910 he held a mathematical professorship first at the Durham College of Science, Newcastle-upon-Tyne, and after 1896 at the University of Durham, where (after 1908) he was also professor of astronomy.

Prof. Sampson's first work on a large scale was the editing of the astronomical papers of J. C. Adams, which demanded critical qualities of no common kind. But the work with which Sampson's name will always be associated is that on the four great satellites of Jupiter. This fell into three main phases, all involving immense labour. The first was the reduction of the photometric observations of eclipses of the satellites made at Harvard, the second was the subsequent production of "Tables of Jupiter's Four Great Satellites". These were carried out at Durham. The third phase was a memoir (1921) containing the theory of the four great satellites of Jupiter. The whole of this work constitutes a monument of industry and power. Much else of Prof. Sampson's work in the domain of optics, solar physics, timekeeping and other subjects are of value, but need no more than mention here. The recent history of the Edinburgh Observatory, with the provision of a 36-in. reflector, is too familiar to call for description. Born in 1866, Prof. Sampson has seen the revolutionary change which has influenced the development of the science to which his life's work has been devoted. A sincere hope may be expressed that he will for many years to come have the happiness of seeing the progress of astronomy continue in the manner he has himself so clearly appreciated. (See also p. 229.)

Prof. J. H. Burn

Prof. J. H. Burn has been appointed to the chair of pharmacology in the University of Oxford. At Cambridge, Burn was president of the Union. After serving as a temporary lieutenant in the Royal Engineers he obtained his M.B. degree in 1920, and joined the staff of the National Institute for Medical Research under Sir Henry Dale. In 1925, he was appointed director of the Pharmacological Department of the College of the Pharmaceutical Society of Great Britain. Later he became Dean of the College, and was given the title of professor of pharmacology in the University of London. During the last twelve years he has been responsible for thousands of pharmacological tests carried out on behalf of manufacturing firms. This work has given him an unrivalled experience of the fundamental scientific work upon which a great industry depends. Through his own work, and that of his colleagues, he has devised new tests and improved old ones for a large number of hormones, vitamins, synthetic chemotherapeutic agents, and plant extracts. Besides all this, he has found time to do fundamental pharmacological work, particularly on vasoconstrictor and vasodilator nerves, and to write several books. He has built up a department which is not only famous for its contributions to knowledge, but has also had a direct effect in raising the standard of pharmaceutical products in Great Britain. With the appointment of Prof. Burn, Oxford should look forward to a period of great activity in her Department of Pharmacology.

Dr. H. S. Harrison

In October next, Dr. H. S. Harrison will retire from the staff of the Horniman Museum, Forest Hill, London, S.E., after thirty-three years service. Dr. Harrison was appointed curator in succession to R. Quick in 1904, not long after the Museum had been transferred to the London County Council by the late Mr. E. J. Horniman. Dr. Harrison re-organized and extended the collections, and the Museum became, and continued to be, under his direction an important centre for lectures on subjects illustrated in the collections, more especially in connexion with the County Council's scheme of lectures for the teachers of the London schools. The value of the collections for the general public was much enhanced by the series of small popular guides written by Dr. Harrison, more especially those on technology, of which "From Stone to Steel" is now in its third edition. Dr. Harrison was formerly honorary secretary of the Royal Anthropological Institute, edited its *Journal* for some years after he relinquished that office, and was president of the Institute in 1935–37. In 1930 he presided over the Anthropological Section at the Bristol meeting of the British Association, when his presidential address, which dealt with the diffusion of culture, aroused no little interest both in Great Britain and, more especially, in the United States by his well-balanced handling of the subject. Dr. Harrison will be succeeded at the Horniman Museum by Dr. L. W. G. Malcolm, who since 1935 had been a member of the inspectorate of the London County Council, and has been engaged in organizing arrangements for the further utilization of the resources of the museum collections of London by the pupils of London schools as part of the educational curriculum. Dr. Malcolm, on coming to England from Australia, was trained as an anthropologist at Cambridge by Dr. Haddon and in Germany. He was formerly curator of the ethnographical collections in the Bristol Municipal Museum and later conservator of the Wellcome Historical Medical Museum.

British Pharmaceutical Conference at Liverpool

The seventy-fourth British Pharmaceutical Conference was held on July 26–30 at Liverpool, this being the fourth occasion upon which Liverpool has given hospitality to the Conference. Mr. T. E. Lescher delivered his presidential address entitled "Pharmacy Today—Its Responsibilities" the main theme of which was the contrast between the important contribution made by pharmaceutical research to the national well-being and the lack of official recognition of this service. Many painstaking chemical, pharmaceutical and biological investigations, said Mr. Lescher, have resulted in placing the treatment of disease increasingly on a scientific basis by the discovery of specific remedies which remove the cause of disease rather than alleviate its symptoms and, of almost equal importance, have, where necessary, enabled these remedies to be taken in a form which does not cause the patient to rebel against them. In view of such achievements, it is surprising that the pharmacist has not received the recognition which his work and responsibilities deserve and which his Continental confrère enjoys. The present system of allowing anyone to handle the majority of drugs and medicines on payment of a five-shilling licence annually encourages the exploitation of the public by the distribution of 'cure-alls' without the slightest guarantee of any knowledge of their properties on the part of the vendor. The official attitude in its latest form is seen in the report of the Select Committee on Medicine Stamp Duties, which recommends what is in effect a sales tax on medicines if claimed to be beneficial to health. It is almost unbelievable that a body of public men should suggest that the State is justified in taxing medical substances used in ill-health.

Julaber's Grave, Kent

The mound or barrow known as Julaber's Grave or Jullieberrie, at Chilham, near Canterbury, has long been an object of interest to archæologists and others, mainly perhaps on account of the lack of precise evidence of its character and age. It is thought to be neolithic, dating from about 2000 B.C. Its excavation has been undertaken by Mr. R. F. Jessup, the author of the volume on Kent in the County Archæology series, on behalf of Sir Edmund Davis of Chilham Castle. The barrow is 144 ft. long, by 45 ft. wide. In the initial operations, which were carried out last year, the course was traced of the ditch running round the mound, from which its material was taken. In the investigations of the present season, a longitudinal section has been cut, following the ditch, which has revealed the construction of the barrow above the original chalk surface. This shows a darker section where the original turves form a core and a loose rubble of chalk from the ditch. A particularly interesting find is recorded (*The Times*, July 31). This is a large circular burial in the side of the mound, probably of Roman date. It shows the cutting through the neolithic layer and the careful replacement of the mixed soil. This is held to support the view that the barrow is the burial place of Laberius Durus, one of Cæsar's generals of the second invasion, of whose name, "Julaber" is thought to be a local corruption. Another interesting find is that of three skeletons at the edge of the ditch at the south end of the mound, three feet below the surface. These have been ascribed to Romans of the third century of our era. They are the remains of a large, well-developed man, a child and a girl. The child's bones were extremely fragile and disintegrated at once, but the small drinking vessel, a platter of rough coarse black ware, and the fibula, which had held the shroud together, were recovered. The girl's remains were fairly well preserved, but those of the man were in an excellent state of preservation.

Angmering Roman Villa

An appeal is issued for funds for the excavation of the extensive Roman villa site near the old village of Angmering, Sussex. The site is situated in the flat meadows which lie between the downs and the sea, beside a Roman road, still to be traced with probability as a farm track between Lyminster and Poling, and as the footpath from Poling to Angmering across the Black Ditch. The site first attracted the attention of archæologists in 1819, when a Roman bath was discovered, with hypocaust, sudarium and sewers. This bath was rediscovered at the beginning of the present year, and the whole bath building is now being uncovered by Mr. R. C. Sherrif and the Littlehampton Archæological Society, with the co-operation of the Sussex Archæological Society, under the direction of Miss Leslie Scott with Dr. R. E. Mortimer Wheeler acting as advisory director. The bath building comprises a dozen or more rooms, some with hypocausts, grouped around a cold-water tank. The building appears to stand by itself, surrounded by a beaten chalk causeway, flanked on the west side by a ditch. It was built in the latter part of the first century, and is interesting both on account of its early date and for the richness of its internal decoration. Beside the usual painted wall plaster and window glass, common on such sites, there is evidence that some walls were faced with slabs of different coloured stones. The bath building was destroyed in the middle of the second century;

but whether it was rebuilt can only be decided by excavation. The villa appears to lie to the west. With so rich a bath house, it should be a fine example of an early Romano-British country house. The cost of the complete excavation will be £500, of which £150 is required to finish the present season's work. The appeal is issued by a Committee of which Mr. E. W. Hulme is the chairman and Mr. E. J. F. Hearne the hon. secretary. Donations should be addressed to Mr. D. Crawford, Hon. Treasurer, Angmering Roman Villa Excavation Fund, Barclay's Bank, Littlehampton, Sussex.

Roman Leicester

EXCAVATIONS, which have now been resumed on the Jewry Wall site at Leicester, have brought to light a remarkable example of the Roman bath, where the Roman forum and basilica were discovered by previous excavations (*The Times*, July 31). The bath is situated in the middle of the open space in the centre of the forum. It is probable that this bath was the largest built in Britain by the Romans. It is on an enormous scale, and comparable to the Imperial baths at Rome. It has one suite for men and one for women, with hot, cold and warm rooms. Miss Kathleen Kenyon, who is again in charge of the excavation, is of the opinion that it was built at the beginning of the fourth century B.C. about two hundred years after the erection of the forum.

Mass-Observation

AT a meeting of the Engineers' Study Group on Economics on July 23, Mr. Charles Madge, joint organizer of "Mass-Observation" (6 Grotes Buildings, Blackheath, London, S.E.3), gave a preliminary account of some of the results already obtained. "Mass-Observation" was begun at the end of 1936 to find out more about everybody's everyday normal life and habits. There are now voluntary observers at work all over the world, and special surveys have been made of the life of the community on certain days. It was found that observers' references to people fall mainly into three categories: (*a*) people one knows or one has met already; (*b*) strangers—people one meets in the street, or for the first time; (*c*) celebrities, one hears of, or reads about in the newspapers. Most reports dealt with the unusual happenings of the day, and the observers had, generally, to be reminded not to overlook the routine happenings. Mr. Madge pointed out that the movement uses both trained and untrained observers, and he stressed the great value of having so many observers who have voluntarily offered to supply information of their immediate surroundings. Although many of them are untrained for this special work, nevertheless, much material of value is being gathered. The chairman (Mr. Alexander Farquharson, secretary of the Institute of Sociology) remarked on the useful relationship that the work carried out by "Mass-Observation" had to that of the sociologist, in supplying raw material not always easily obtainable.

Utilization of Leisure

AT a subsequent meeting of the Engineers' Study Group on July 30, Mr. M. M. Bruce, secretary of the London Council of Social Service (7 Bayley Street, W.C.2) outlined the results of a survey undertaken in co-operation with other bodies (L.C.C. Education Department, Y.M.C.A., Young Communist League, trade unions, co-operative societies, Workers Educational Association) to determine how young people between the ages of fourteen and twenty-five years spend their leisure. Some 5,000 answers—an admittedly insufficient sample—were received, which gave an indication of the wide variety of interests. The largest proportion of predilections expressed for any one type of recreation goes, with young men to outdoor sports (11 per cent) and with girls to dancing (30 per cent). The influence of the cinema was very evident in the choice of girls' fashions and hair-dressing styles. A tendency away from organized sports (football, etc.) towards the more individual type (rambles) was also noticeable. The investigation is being continued by a smaller committee, which is looking further into these particular aspects. The survey acquires a particular significance in view of the fact that the Government will, in the autumn, begin a campaign to improve both the physical and the mental abilities of the people of Great Britain.

Annual Report of the Astronomer Royal for Scotland

THE forty-seventh annual report of the Astronomer Royal for Scotland records the work done at the Royal Observatory, Edinburgh, for the year ending March 31, 1937. The daily time service for the city of Edinburgh was maintained without change. The transit circle was used exclusively to determine time. An apparatus installed during the year by H.M. Office of Works enables the mains supply to be used as the electrical power maintaining the winding of the clocks. Provision is made automatically for a temporary breakdown in the mains supply, by means of a secondary battery which is kept fully charged by a trickle from the mains. The 6-inch photo-visual refractor has been fitted with a synchronous drive. The solar spectroscope is being used to obtain spectra of the east and west limbs of the sun's disk to determine the solar rotation from the measured Doppler effect. The seismograph provides daily records which are available to other workers in this field. Observations with the 36-inch reflector were interrupted in order to have the great mirror aluminized by a reputable firm. Unfortunately the aluminium coating was not a success, and the mirror was then resilvered at the Observatory. A number of plates were taken with the 10-inch triplet as part of a programme for a search for variable stars near the Selected Areas centred around declination + 75° and + 60°, the plates being examined with a blink comparator. Among the meteorological observations, it may be noted that the maximum shade temperature was 75° F. on August 28 and the minimum of 24° F. on December 7 and February 11. The deep rock thermometers at a depth of 250 inches on Calton Hill gave a minimum temperature on June 8 of 46·3°

and a maximum of 48·3° on December 14, thus showing, as usual, a greatly reduced annual amplitude and almost a complete reversal of seasons at this depth. (See also p. 227.)

The Treub Foundation of Buitenzorg, Java

DR. K. W. DAMMERMAN, director of the Botanic Gardens, Buitenzorg, has sent us a copy of the first report of the Treub Foundation (Treub-Stichting), which was established at the end of last year for the administration and application of the Treub Fund collected in Netherlands India. When, in 1933, the Government of Netherlands India had, for reasons of economy, to make substantial reductions in the grants to the biological establishments at Buitenzorg, a committee was formed to collect donations for this Fund; and the Government gave permission for any sums received from the sale of surplus plants to be added to the Fund. The Treub Foundation has now been legally constituted to take over and administer this Fund.

THE object of the Foundation is to co-operate in maintaining, and, if possible, in extending the scope of, the scientific institutions united under the name of the 'Government Botanic Gardens', namely, the Botanic Gardens at Buitenzorg and Tjibodas, the Treub Laboratory, the Herbarium, and the Zoological Museum and Laboratory at Buitenzorg, and the Marine Investigation Laboratory at Batavia. The Foundation distinguishes donors, patrons, subscribers and corresponding members. Donors are corporations which contribute one sum of at least Fl. 1,000 and persons who contribute one sum of at least Fl. 500; and patrons those who contribute one sum of at least Fl. 100; subscribers contribute at least Fl. 10 annually. Persons who, because of their interest in the Government Botanic Gardens or in scientific research in the Dutch East Indies, are appointed corresponding members will not be obliged to pay any subscription, but, in their own countries, will look after the interests of the Buitenzorg Institutions in co-operation and in concert with the Foundation. The chairman of the Foundation is Mr. J. H. B. Kuneman, member of the Council of Netherlands India; the secretary is the director of the Government Botanic Gardens, and the treasurer, the president-director of the Java Bank. The capital of the Foundation amounted to about Fl. 20,000 on December 31, 1936. Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, has accepted an invitation to act as a corresponding member of the Foundation in Great Britain, and Dr. David Fairchild, Prof. Elmer D. Merrill and Dr. Thomas Barbour have been appointed corresponding members in the United States.

Phenology of 1936

THE Phenological Report for 1936, recently issued by the Royal Meteorological Society, contains the usual mass of statistics, maps, graphs, etc. of the relations between fauna, flora and the weather. It is the forty-sixth report, compiled mainly by Ivan D. Margary, from 477 reporters. The year was remarkable for its sunlessness generally, for wetness in England and Wales, and a cool winter, so that plants generally flowered late—all in the Midlands, nearly all England, south-east, south-west, and south Ireland, but were earlier in Scotland, especially the west. Insects nearly all appeared late in England, and save for Scotland, spring migrants were generally late because of the cool April; the autumn migrants were mostly early in moving. As in 1934, the lesser celandine was very late, but by early April vegetation had made up the lost ground; late frosts damaged potatoes, beans and most tender growths; fungi were scarce after August, although flowers were especially fine in the dry, sunny late summer and autumn; trees often remained green late, and wind, more often than frost, caused the leaf-fall. A considerable amount of second flowering was noted in autumn on elder, laburnum, dog-rose and apple. Wild fruits did not do so well as cultivated ones, where bumper crops of apples, plums and raspberries were obtained. Garden crops did good, cereals bad, and hay was ruined by rain. After a record early wave of migrants in March, the long April frost caused a marked hold-up until the sunny third week. Bird song was less in the May drought and cold early June; redwings and fieldfares were scarce in the mild winter. An increase in red squirrels was noted in south-west England; but grey squirrels hold their own in the south-east.

An Extra Receiver for the Telephone

BEFORE the introduction of the modern form of hand micro-telephone instrument and before thermionic amplifiers were introduced on trunk telephone lines, the extra receiver was considered a useful means of improving reception. In modern times the popularity of this receiver has greatly declined. At first sight it would look as if when listening with both ears to a long distance call or when in a noisy room it would be a great improvement; but this is rarely the case owing to what is called side-tone, that is, the reproduction by the receiver of room-noise falling on the microphone at the same station. It is far more difficult to sort out the wanted from the unwanted sounds when both are entering both ears, than when one ear alone is used. In the Engineering Supplement to the *Siemens Magazine* of April a new type of the extra receiver is described. It is pointed out that in certain circumstances it is very useful to have an additional receiver. It enables a third person to listen to the conversation and, if necessary, make notes. As this facility is only required occasionally, and if this receiver were always left in circuit it would permanently 'degrade' the hearing, a switch actuated only when the 'watch' receiver is pressed against the ear is introduced in the circuit. Incidentally, this receiver enables the user to know when he is using sufficient pressure. It is not sufficiently recognized that in everyday use, pressing the telephone too lightly against the ear distorts sounds communicated. In the new table pattern 'neophone' telephone, the extra watch receiver is hung up by a hook. When lifted off and pressed against the user's ear, it is immediately available.

Hebrew University of Jerusalem

THE Hebrew University of Jerusalem, now entering on its thirteenth year, is making a special appeal to the Anglo-Jewish community for increased financial support. A pamphlet issued by its "Friends" (199 Piccadilly, London) gives some account of the University's growth and present status. In grounds covering sixty acres on Mount Scopus, its buildings already include institutes of chemistry, physics, mathematics and meteorology, a library containing more than 300,000 books and an open-air theatre. A hospital and graduates' medical school and nurses' home are under construction, and plans have been prepared for a building for Jewish studies and the humanities. A department of radiology and experimental pathology, at present housed in the Straus Health Centre in Jerusalem, is engaged in cancer research, financed by a special endowment of £40,000. In a letter, reproduced in the pamphlet, signed by Lord Rutherford, Prof. Albert Einstein, Sir F. Gowland Hopkins, Sir William Bragg and others, it is pointed out that the University is the only one throughout the Near and Middle East in which scientific and scholarly research is a principal activity, and that some of the widely recognized work of its scientific institutes has been of immediate value to the whole population of Palestine. The director of its department of parasitology, engaged in the study of Mediterranean diseases, was chosen by the Royal Society to carry out investigations. Its department of hygiene and bacteriology maintains a malaria research station and has received subventions for its work from the Health Organization of the League of Nations and the Government of Palestine. Jews in the United States contribute nearly half towards the annual budget of £80,000. Apart from endowments for two chairs and several scholarships, the Jewish community in England has hitherto borne an insignificant part.

Universities of Poland

POLAND'S universities are described in a bulletin recently published by the United States Government Printing Office, Washington (pp. 160. 25 cents). It is one of a series of studies undertaken at the request of the American Association of Collegiate Registrars by the Comparative Education Branch of the United States Office of Education. The institutions of higher education in existence in November 1918 within the boundaries of the new State then constituted reflected the influences, German, Austrian and Russian, of the Governments in whose territory they had been located, but have since been brought, along with a larger number of new institutions, into an organized scheme of training on university levels, all under the strict control of the Ministry of Public Instruction. The total number of regular students is 56,000, being one to 589 of the total population, a high proportion in comparison with those obtaining in other countries. The pressure for admission to many of the institutions such as the polytechnics, academy of mines and the medical schools of the universities, is so great that selection is made by competitive examination from among the qualified candidates. In the small Free Polish University of Warsaw has lately been instituted an ingenious scheme under the name "Universitas Rediviva" for equipping aspirants to a liberal culture with a knowledge of things in general. The name refers to the medieval ideal of a university.

Science in Australia and New Zealand

THE Australian and New Zealand Association for the Advancement of Science is taking steps to give effect to the resolutions passed at the Auckland Meeting last January amending the constitution and by-laws relating to membership. Hitherto, ordinary members have paid a subscription of one guinea for each biennial session of Association; but it has been decided now to institute annual membership (one guinea per annum) and an elected fellowship (two guineas per annum). The fellows resident in Australia will constitute a committee to be known as the Australian National Research Council, which will have at its disposal for research and other purposes a sum not exceeding one half of the subscriptions of fellows and annual members resident in the Commonwealth. The Council will take over all the assets and responsibilities of the existing body of the same name which was brought into being early in the post-War period as the Australian member of the International Research Council. It is anticipated that one of its activities will be the institution of a periodical for the encouragement and dissemination of scientific knowledge among members of the general public.

The Brisbane Seismological Station

AN important and very welcome addition has recently been made to the chain of Australian seismological stations at Sydney, Melbourne, Adelaide and Perth. As an aid to the study of earthquakes in the south-west Pacific region, a station farther to the north was greatly needed. Interest in the foundation of one in Queensland was aroused by the occurrence of a tremor at Gayndah in April 1935, and a former student in the University of Brisbane offered to provide a Milne-Shaw seismograph. Later, the Council for Scientific and Industrial Research added a second instrument, so that both north-south and east-west components can now be recorded. According to an account given in the *Courier-Mail* (Brisbane) of June 2, the instruments are installed in the basement of the University's new library block. They were placed temporarily on their foundations about midday on May 31, and at 3.30 the next morning recorded an earthquake with its origin about 1,450 miles from Brisbane. The new station has been placed under the direction of Dr. W. H. Bryan, lecturer in geology in the University.

The American Chemical Society

THE ninety-fourth meeting of the American Chemical Society will be held in Rochester, New York, on September 6–10, under the chairmanship of Mr. M. H. Eisenhart, president of the Bausch and Lomb Optical Co. Seventeen professional divisions of the Society and the Microchemical Section will hold sessions. Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, will deliver the annual presidential address of the Society on September 7. At the twenty-three symposia, the following subjects will be discussed: developments affecting industry, nutrition, public health, pure science, and education; artificial radioactivity and its chemical uses, studies of the chemistry of the earth's crust, low temperature methods and research, chemical microscopy, quantitative spectroscopic analysis, and photography; chemistry and physics of electrical insulation; medicinal patents, vitamins, and the chemistry and metabolism of fats; cellulose derivatives; organic plastics; 'unit processes' and 'automatic control'; characteristic properties and chemical utilization of hydrocarbons; 'gaseous combustion'; investigations dealing with sugar, rubber, water, sewage, and sanitation, microchemistry, organic chemistry, fertilizers, and colloids.

The Selborne By-Pass

THE Selborne Society, which for fifty-two years has cherished the memory of Gilbert White, invites admirers of his life and work to make a copy of the following protest and send it signed to the Secretary of the Selborne Society, The Hermitage, Hanwell, London, W.7, so that it may be forwarded to the proper authority with the Society's own,: "Understanding that powers are to be sought to drive a road, in the future, through the grounds of The Wakes at Selborne between the house and the Hanger which Gilbert White loved so well, I wish to protest against what would be an offence to the memory of a very great Englishman who made his village famous throughout the world and to urge that an alternative scheme, if necessary, be adopted.

Indian Institute of Science, Bangalore.

IT is reported in *The Statesman* (India) of July 21, that, at a meeting of the Governing Council of the Indian Institute of Science, Bangalore, held on the previous day, Sir C. V. Raman accepted the appointment of professor of physics at the Institute at a monthly salary of 2,500 rupees (£187). The Council has appointed an interim director on a monthly salary of 1,000 rupees for one year, in addition to a registrar on 1,250 rupees. Rao Bahadur B. Venkatesachar, a member of the Council, has taken over charge of the directorship from Sir C. V. Raman and the latter has thus been relieved of all administrative duties, including the secretaryship of the Governing Council. The registrar is Mr. C. E. W. Jones, formerly director of public instruction, Central Provinces, who took up his new duties on July 31. (See also NATURE of June 26, p. 1102.)

'Vaseline' Products

THE manager of the Chesebrough Manufacturing Co., Victoria Road, Willesden, London, N.W.10, writes to point out that the word 'vaseline' is wrongly used in a letter by Mr. L. Bellingham in NATURE of July 10, and in the summary of the letter. The word is not a common designation, but "is the trade mark or brand name used to distinguish the particular products marketed by this Company". The manager asks that the word 'vaseline' should not be used "unless in conjunction with and as the brand name applied to one of our products, such as 'Vaseline' Petroleum Jelly".

A History of Chemistry

AN interesting handbook issued by the Science Museum, London, S.W.7, entitled "Chemistry, a Brief Outline of its History and Development", by A. Barclay, gives an account of the history of chemistry, and is well illustrated, in some cases with representations of historical apparatus in the Museum. Apparatus used by Davy, Faraday, Graham, etc., is included. There are a good index and a bibliography. The subject is dealt with from the earliest period to modern times, the last section being on atomic structure. The handbook forms a useful and interesting supplement to text-books on chemistry. The price is 1*s*. 6*d*., post paid 1*s*. 8*d*., from the Museum or the sales offices of H.M. Stationery Office.

Announcements

THE Baly Medal for 1937 of the Royal College of Physicians has been awarded to Prof. E. L. Kennaway, professor of experimental pathology in the University of London and director of the Research Institute of the Cancer Hospital (Free), London. The award is made in recognition of Prof. Kennaway's biochemical investigations, which have led to the identification of a group of substances provoking malignant growth of tissues and having significant relations in structure to certain hormones and vitamins.

THE Warren Research Fund Committee of the Royal Society has appointed G. S. Hartley, of University College, London, and J. T. Randall, of the General Electric Co., Ltd., to Warren research fellowships, each to be held for four years in the first instance. Mr. Hartley proposes to carry out research on oil drops, films and solutions, and Mr. Randall will undertake a research on the mechanism of fluorescence in pure and impure solids.

THE Ministry of Health has approved the application of the Birmingham Corporation for sanction to a loan of £8,505 for the provision of a forensic science laboratory for the detection of crime.

THE publishers of NATURE have in stock a certain number of bound volumes for which space can no longer be found. The volumes extend from vol. 1 to vol. 91, with the exception of the following: vols. 3, 8, 15, 17, 19, 22, 23, 24, 25, 51, 53, 74, 76, 77, 79, 80, 83, 84, 85, 86. Librarians and others wishing to complete their sets of NATURE can be supplied with any of the volumes in stock, so long as the stock lasts, at the price of 2*s*. 6*d*. per volume, carriage paid. Application, with remittance, should be addressed to NATURE Office, St. Martin's Street, London, W.C.2. Volumes which are not applied for by the end of this year will be destroyed.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 242.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils

WHEN vitamin A concentrates from marine fish livers are treated with antimony trichloride the blue solution normally exhibits an absorption maximum near 620 mμ with a subsidiary masked maximum near 583 mμ (displaced to 606 mμ and 572 mμ respectively in oils of low potency). In exceptional cases, however, additional maxima at 635, 645, 656, 680 and 690–695 mμ have been recorded[1]. The '693 chromogen' appears to be the most important of these extra chromogenic substances and follows the vitamin A during concentration into the richest fractions. When this chromogen has been recorded previously, in halibut oils, the intensity has usually been about one tenth of that due to the 620 chromogen[2]. Recently, however, liver oils from certain Russian freshwater fish have been reported that gave antimony trichloride solutions exhibiting clear maxima at 645 or 690 mμ and only a weak band near 620 mμ[3].

TABLE 1.

Species	Liver oil or concentrate	Ultra-violet absorption		Antimony chloride blue test		Ratio of intensities 693/620
		Maxima† mμ	$E^{1\%}_{1\,\text{cm.}}$	Maxima† mμ	$E^{1\%}_{1\,\text{cm.}}$	
Catfish (*Silurus glanis*)	C	343 (281)	203 102	695 (620)	560 292	1·92
Pike (*Esox Lucius*)	C	345 (280)	187 124	695 (620)	445 240	1·85
Pike-perch (*Lucioperca Lucioperca*)	Oil	348 (283)	4·0 3·0	693 (606)	8·1 3·45	2·35
Bream (*Abramis brama*)	C	340 280	58·5 36	697 (620)	97 58	1·67
Sturgeon (*Acipenser Stellata*)	Oil	334	3·5	695 617	5·8 4·4	1·32
Sturgeon (*Acipenser Guldenstadtii*)	Oil	330 (280)	2·3 2·1	695 620	3·6 2·7	1·33
Salmon (*Salmo Salar*)	Oil	349 282	14·2 11·8	695 (617)	33·9 14·2	2·38
Salmon (*Onchorhynchus keta*)	C	327 (280)	73 53	695 620	51·5 125	0·41
Halibut* (*Hippoglossus Hippoglossus*)	Oil	328	71·5	697 620	30 170	0·17

* This is a typical marine fish liver oil.

† Values in brackets indicate only ill-defined bands.

We have since examined liver oils and concentrates from various freshwater fish by quantitative spectrophotometric methods and have consistently found them to be abnormal in exhibiting an absorption band in antimony trichloride solution at 690–697 mμ, or less commonly at 645 mμ, having an intensity *greater than* that of the 620 band. Up to twenty catches of each of the species quoted in the table were examined, the fish being obtained from the Volga or Don, or rivers in the Leningrad region.

We have also found, in addition, that the ultraviolet absorption spectra of the liver oils of freshwater fish are differentiated from those of marine fish, in that the maximum is displaced from 328 mμ to 345–350 mμ (with, frequently, the appearance of another band at 280–285 mμ). The 340–350 mμ maximum thus appears to be associated with the 693 mμ antimony chloride chromogen, just as the 328 mμ band is associated with the 620 mμ chromogen.

Although most freshwater fish liver oils show only one band near 693 mμ in chloroformic antimony trichloride, the absorption near 620 mμ is always appreciable. Thus the 693 : 620 intensity ratio seems to average 2 : 1, whereas for marine fish it is usually less than 0·2 : 1 (*cf.* Table 1 for the spectroscopic data on a few typical oils and concentrates).

The chromogenic properties of the two classes of liver oils reported here are closely parallel with those recently observed by Wald[4] when examining the retinas of marine and freshwater fish respectively. It appears possible to us that the 693 mμ chromogen may be a second vitamin A with some degree of specificity for freshwater fish, and in this connexion an alcohol with six conjugated ethenoid linkages is obviously suggested as a possibility by the spectrographic data. We are at present engaged in an attempt to isolate the compound, and we also have the biological aspect of the question under test. It should, however, be noted that, until both biological and spectrographic data have been accumulated and examined, the accurate determination of the vitamin A content of liver oils of freshwater fish, by physicochemical methods, is not possible.

E. LEDERER.
V. ROSANOVA.
Vitamin Institute,
Leningrad.

A. E. GILLAM.
I. M. HEILBRON.
University,
Manchester.

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[1] Heilbron, Gillam and Morton, *Biochem. J.*, 25, 1352 (1931).

[2] Heilbron, Heslop, Morton, Webster, Rea and Drummond, *Biochem. J.*, 26, 1178 (1932).

[3] Lederer and Rosanova, *Biochimica*, 2, 293 (1937).

[4] Wald, NATURE, 139, 1017 (1937).

A Possible Vitamin A_2

THE antimony trichloride colour test for vitamin A is associated with a maximum absorption at 620 mμ. We have, since 1929, repeatedly encountered an additional band near 693 mμ, but further characterization of the chromogen has been hindered by the presence of excessive amounts of vitamin A. Thus, in halibut liver oils the relative intensities 620 mμ/693 mμ are c. 6 : 1, and in halibut visceral oils 10 : 1. The 693 mμ chromogen is rarely detectable in cod liver oils and never in our experience in whale liver oils.

It is frequently absent from the vitamin A fraction of eyes, but one of us (J.R.E.) has observed the 693 mμ band in extracts from goldfish eyes, the ratio 620 mμ/693 mμ being c. 1 : 1·5. Experiments on brown trout have shown that the 693 mμ chromogen occurs in the non-saponifiable extracts from livers and viscera. The 620 mμ band, as such, could not be detected. Direct absorption spectra showed the presence of three broad bands with maxima at 470, 350 and 287 mμ, respectively, the ultra-violet bands varying in intensity with the 693 mμ band in the colour test. Lederer and Rosanova[1] have also found an intense band at 693 mμ in the colour test applied to freshwater fish liver oils from the neighbourhood of the Murmansk Sea. We understand (private communication) that an apparent connexion between absorption bands at c. 345 and 285 mμ and the 693 mμ chromogen has been confirmed by Prof. Heilbron and Dr. Gillam on Lederer's oils. Wald's discovery that a substance apparently identical with the 693 mμ chromogen can replace the vitamin A of rhodopsin *without loss of physiological function* runs parallel with the similar replacement in the viscera and liver of brown trout. It therefore seems desirable provisionally to designate as 'vitamin A_2' the 693 mμ chromogen with its characteristic ultra-violet absorption.

In chemical separations with liver oils, the 693 mμ chromogen follows vitamin A, the ratio 620 mμ/693 mμ for a given species remaining very nearly constant. It is not difficult with some liver oil extracts to reach $E^{1\%}_{1\text{cm.}}$ 693 mμ 500–1,000, but judging from the amount of vitamin A present, the pure substance will have $E^{1\%}_{1\text{cm.}}$ 693 mμ $\not<$ 5,000. On this basis, each brown trout contains of the order 0·12 mgm. of the new material.

It seems clear that the 693 mμ chromogen is not in any simple sense an artefact derived from vitamin A; but the position remains obscure with regard to bands at 640 mμ and 660 mμ which occasionally appear in the colour test.

J. R. EDISBURY.
R. A. MORTON.
G. W. SIMPKINS.

University of Liverpool.
July 6.

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[1] *Biochimica*, **2**, 293 (1937).

Specificity of Indophenol in the Estimation of Ascorbic Acid in Fermented Products

DURING the course of an investigation on the antiscorbutic value of Kaffir beer, it was observed that beers treated with a 2 per cent concentration of metaphosphoric acid gave high values for 'vitamin C' when titrated with indophenol in the usual manner, the values varying between 1·1 and 38·5 mgm./100 ml.

Delf[1], working with guinea pigs and monkeys, concluded that Kaffir beer was of slight antiscorbutic value. Levy and Fox[2], using hydrochloric acid for acidification, examined eleven specimens of mine-brewed beer and found values of 0·2–0·5 mgm./100 ml.

Bernhauer *et al.*[3] showed that when *Aspergillus niger* was allowed to grow in sugar mixtures, substances with the same reducing properties as ascorbic acid were formed. Whether these possessed antiscorbutic activity or not was not clear (Křiženecký and Nevalonnyj[4] and Hermann and Fodor[5]).

As with ascorbic acid, norite charcoal (Fox and Levy[6]) completely removed the reducing power. However, only a small fraction (0·8 mgm. out of 13·0 mgm.) was restored after hydrogen sulphide treatment. Hubbard squash extract (Tauber *et al.*[7]) entirely removed the reducing power. The folin uric acid reagent (Medes[8]) gave identical values with indophenol titration in the presence of 2 per cent metaphosphoric acid.

The effect of *p*H on the indophenol titration of the beer was as follows:

INDOPHENOL REDUCING POWER OF KAFFIR BEER AT DIFFERENT *p*H VALUES.
(in mgm. 'ascorbic acid' per 100 ml. beer).

2·5 *N* HCl		8·0
1·2 *pH*		0·8
1·4		0·8
1·6		0·8
1·8		0·8
2·0	(doubtful end-point)	1·5
2·2		13·0
2·4		13·0
2·6		13·0

Guinea pig experiments showed the reducing substance to be almost devoid of antiscorbutic activity, the animals dying of scurvy in three to four weeks. Controls on orange juice remained healthy, and on autopsy showed no signs of scurvy.

The reducing power of the beer was followed at different stages of its preparation, and it was found that a large increase took place during the boiling of the mash, and a further increase during fermentation.

From these experiments it is concluded that the bulk of the reducing substance is not ascorbic acid. The true ascorbic acid content of the beer probably corresponds to the values of about 0·8 mgm./100 ml. obtained with the norite procedure and by titration at a *p*H between 1·2 and 1·8. The concentration was far too low to have any appreciable effect on the guinea pigs in the doses given. It is also shown that ascorbic acid oxidase (cf. Zilva[9]) and Srinivasan[10]), and the folin uric acid reagent (cf. Fujita *et al.*[11]) are not specific for ascorbic acid.

F. WILLIAM FOX.
WILLIAM STONE.

Biochemical Department,
South African Institute for
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Johannesburg.
June 21.

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[1] Delf, *Publ. S. Afr. Inst. Med. Res.*, **2** (No. 14), 47 (1921).

[2] Levy and Fox, *S. Afr. Med. J.*, **9**, 181 (1935).

[3] Bernhauer, Görlich and Köcher, *Biochem. Z.*, **286**, 60 (1936).

[4] Křiženecký and Nevalonnyj, *Z. Untersuch. Nahr. u. Genussm.*, **66**, 278 (1933). (Quoted by Bernhauer *et al.* (3).)

[5] Hermann and Fodor, *Biochem. Z.*, **276**, 323 (1935).

[6] Fox and Levy, *Biochem. J.*, **30**, 208 (1936).

[7] Tauber, Kleiner and Mishkind, *J. Biol. Chem.*, **110**, 211 (1935).

[8] Medes, *Biochem. J.*, **29**, 2251 (1935).

[9] Zilva, *Biochem. J.*, **30**, 1215 (1936).

[10] Srinivasan, *Biochem. J.*, **30**, 2077 (1936).

[11] Fujita, Akiji and Ebihara, *Biochem. Z.*, **290**, 182, 192 (1937).

Absorption of the Soft Component of Cosmic Radiation

It is now generally accepted that the soft component of cosmic radiation consists of electrons which are absorbed mainly by emission of light quanta and subsequent production of pairs (cascade showers). The absorption of these particles is usually measured by two or more counters separated by a plate of some absorbing material of variable thickness. This method measures the probability of a primary electron either itself penetrating the plate or producing at least one secondary electron emerging from the bottom of the plate.

Since the probabilities for the relevant processes are proportional to Z^2, it is often assumed that the absorption curves for the soft component should be independent of the material when plotted on a scale proportional to NZ^2 (N = number of atoms per c.c.). This assumption, however, rests on an erroneous interpretation of the theory for the following reason.

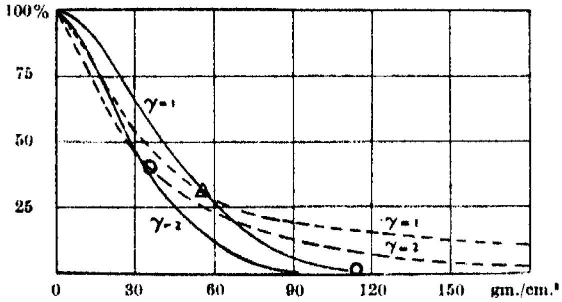

Fig. 1.

The production of secondaries by the cascade process only takes place if the energy is higher than the critical energy E_z at which the energy loss by radiation is equal to the energy loss by ionization. E_z is larger for light materials than for heavy ones. ($E_z = 10 \times 10^6$ e.v. for lead; 60×10^6 e.v. for aluminium; 150×10^6 e.v. for air.) Thus, the shower electrons from light materials will be more energetic than those from heavy materials. Naturally, the probability for the production of fast secondaries is smaller than that for slow ones. If we plot, therefore, the absorption curves on a Z^2-scale, we should expect the curves to fall off more rapidly for light elements than for heavy ones.

We have calculated, on the basis of the quantum theory[1], the probability for an electron penetrating a plate of certain thickness or producing at least one secondary with energy greater than E_z. The curves obtained depend on the primary energy spectrum of the electrons. We have assumed a $dE/E^{\gamma+1}$ law and have put $\gamma = 1$ and 2. For E smaller than the critical energy E_z for air, we assume the energy spectrum to fall off rapidly, the exact shape of the energy spectrum being of no importance for the result. The shape of the absorption curves is mainly determined by primary electrons with comparatively small energies, for which the validity of the theory is proved by direct experiments[2] (that is, up to 3×10^8 e.v. for lead and 10^9 e.v. for aluminium). The high-energy part of the spectrum only affects the tail end of the curves, which in any event cannot readily be distinguished from the hard component. (In Fig. 1 the curves are calculated assuming that the theory is valid for all energies.

Fig. 1 shows the theoretical absorption curves for lead (full) and aluminium (dotted) on an ordinary gm./cm.² scale. We see that to a rough approximation the curves follow an *ordinary mass absorption law*. The experimental points (○ for Pb, △ for Al) are taken from the measurements by Auger, Ehrenfest and Leprince-Ringuet[3]. They are in good agreement with the theory for γ between 1 and 2. The accuracy is, however, not high enough to determine γ exactly.

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[1] Carlson and Oppenheimer, *Phys. Rev.*, **51**, 220 (1937). Bhabha and Heitler, *Proc. Roy. Soc.*, A, **159**, 432 (1937).

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Capture of Orbital Electrons

In two recent papers[1] Møller has shown that on the present theory of β-decay for a heavy nucleus emitting positrons of low maximum energy, the ratio F_k/F of the probability of K-electron capture to that of positron emission may be large. On the other hand, experiments by Jacobsen[2] for a light nucleus (radio-scandium, $W_0 = 1 \cdot 1 \pm 0 \cdot 1$ MV., $Z = 21$) show that this ratio is < 1/10. We wish to point out that Jacobsen's result is in agreement with a modified form of the theory[3], but that this form makes a definite prediction about the low energy end of β-spectra.

The usual procedure of writing the interaction term as

$$(\psi_N^* \mathbf{A}' \psi_P)\,(\psi_e^* \mathbf{A}'' \psi_n) \qquad \ldots\ldots\ldots \qquad (a)$$

where (N,P) (n,e) represent the heavy and light particles respectively, leads to a transition probability[4]

$$A \left| \int \psi_N^* \psi_P d\tau \right|^2 (\psi_e^* \psi_e)(W_0 \pm W)^\alpha \quad \begin{array}{l} \alpha = 2 \text{ Fermi} \\ \alpha = 4 \text{ Konopinski-Uhlenbeck} \end{array}$$

The ± sign depends upon the electron being absorbed from a state of positive or negative energy. For the ratio F_k/F the evaluation of $(\psi_e^* \psi_e)$ from the known form[5] of the wave-functions for a K-electron, gives for small Z

$$F_k/F = 2\pi\gamma^3(W_0 + 1)^\alpha \Big/ \int_1^{W_0} W(W^2 - 1)^{1/2}(W_0 - W)^\alpha \quad \begin{array}{l} \alpha = 2 \text{ Fermi} \\ \alpha = 4 \text{ Konopinski-Uhlenbeck} \end{array}$$

where $\gamma = Z/137$.

If $Z = 21 \cdot 0$, $F_k \sim 0 \cdot 22$ for $\alpha = 2$, and $2 \cdot 3$ for $\alpha = 4$. F depends sensitively upon the exact value of W_0, varying from $0 \cdot 63$ to $1 \cdot 17$ in the Fermi case, and from $0 \cdot 39$ to $1 \cdot 0$ in the Konopinski-Uhlenbeck case, as W_0 varies from $2 \cdot 2\ mc^2$ to $2 \cdot 4\ mc^2$. We therefore require a very precise knowledge of W_0 to determine F_k/F exactly. Even with $W_0 = 2 \cdot 4\ mc^2$, F_k/F is about 1/5 for $\alpha = 2$, and $2 \cdot 3$ for $\alpha = 4$, so that the K-electron capture could scarcely have been overlooked, particularly in the Konopinski-Uhlenbeck case.

There is the further possibility of writing the interaction term in the form

$$(\psi_N^* \mathbf{A}' \psi_n)\,(\psi_e^* \mathbf{A}'' \psi_P) \qquad \ldots\ldots\ldots \qquad (b)$$

(This corresponds to the case $C = -1$ in the note recently published by Mercier[6]. For this value of C, however, the formulæ there given are not applicable.)

For $Z \sim 20$ the components ψ_1, ψ_2 of the K-electron are small compared with the components ψ_3, ψ_4. Similarly, ψ_P has two large and two small components differing by a factor of the order of 1/10. We may suppose A'' to be an operator combining the two small components of ψ_P with the two large components of ψ_e^*. This arrangement gives a factor 1/100 in the terms containing the small proton components, and a factor 1/200 in the terms containing the small electron components. Thus, by addition, F_k/F will contain a factor 3/200 from this combination; that is, for $Z = 21 \cdot 0$, we may take F_k to be 0·003 for $\alpha = 2$, and 0·035 for $\alpha = 4$. The positron emission will now be given by

$$F = A \int_1^{W_0} (W + 1)(W^2 - 1)^{1/2} (W_0 - W)^{\alpha} dW \qquad (c) \quad \begin{array}{l} \alpha = 2 \text{ Fermi} \\ \alpha = 4 \text{ Konopinski-Uhlenbeck} \end{array}$$

F will again depend sensitively upon the value of W_0, but we can take as suitable values 1·5 for $\alpha = 2$ and 0·75 for $\alpha = 4$. This gives for F_k/F approximately the values 1/500, $\alpha = 2$, and 1/25, $\alpha = 4$. It is possible that K-electron capture for the ratio 1/25 has escaped detection, although its existence should be revealed by further experiments. The interesting point arises that, if the $\alpha = 4$ interaction is assumed, we obtain a definite prediction of the low-energy end of the positron spectrum, which is given by the integrand of (c). This leads us to expect a large number of slow positrons. It is important to note that this latter conclusion seems to hold only for allowed transitions. *For forbidden transitions* (c) has a more complicated form.

In the Fermi theory, F_k/F is about 1/3 or 1/500 according as one adopts the law (a) or (b). The actual interaction law may also be a linear combination of (a) and (b), and it is easy to calculate the proportion necessary to give any intermediate ratio. It should be noted that, as this ratio decreases from 1/3, we require a rapid increase in the percentage of (b); for example, when the ratio has decreased to 1/30 we already need more than 90 per cent of the interaction (b).

We see that if we accept the experimental evidence that the probability of absorption of a K-electron relative to that of positron emission is less than the value required by the Konopinski-Uhlenbeck theory, then the theory must be replaced by a modified form which gives many more slow positrons and fewer slow electrons. This appears to be in reasonable agreement with the direct observation of the spectrum.

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[3] Hoyle, *Proc. Camb. Phil. Soc.*, 33, 286 (1937).

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Structure of Hα of Hydrogen

THE structure of the lines of the Balmer spectrum of hydrogen was investigated in this laboratory some years ago. Recently we have attacked the problem again, using two Lummer plates, not crossed as in the investigations of Kent, Taylor and Pearson[1], but dispersing in the same plane. With this arrangement, the microphotometer curves of the resultant pattern reveal clearly four distinct components of Hα with intensities and positions roughly as given by theory. There are no ghosts in the Lummer plates and the interference of lines of the secondary spectrum of hydrogen has been eliminated.

We are now engaged in obtaining quantitatively the intensity and position of these components.

We feel that this method (now, so far as we know) may be of service in the study of the fine and hyperfine structure of the spectrum lines of other elements.

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[1] *Phys. Rev.*, 30, 266 (1927).

Raman Spectra of Oxonium Compounds

M. WOLKENSTEIN and G. K. Syrkin have published in a recent communication in NATURE[1] the Raman spectrum of equimolecular mixtures of ether and hydrogen chloride in the liquid state[1]. In 1935 we studied[2] the Raman spectrum of the system ethyl ether plus hydrogen bromide at low temperatures (228° K.) and announced there further work on this subject. The publication of these results was delayed owing to unforeseen circumstances.

We investigated solutions of the compounds $CH_3OH + HCl$ (HBr), $C_2H_5OH + HCl$ (HBr), $(CH_3)_2O + HCl$ (HBr) and $(CH_3)_2CO + HCl$ (HBr) in excess of hydrogen halides. The compounds were prepared, dissolved in excess liquid hydrogen halide and the resulting solution filled into the Raman tube, all in one operation, in a high vacuum apparatus at low temperatures, thus eliminating all possibilities of chemical reaction (formation of R. Hal.). Under these conditions, we obtained spectra of the solutions, which were characteristically different from the spectra of the components. We obtained the following frequencies:

CH_3OH . . . HCl ($t = -75°$ C., molecular ratio = 1 : 1·8). 465(2), 645(3), 991(4), 1088(5), 1181(1), 1357(3), 1449(5), 2956(10), 3019(7), 3364(3).

CH_3OH . . . HBr ($t = -62°$ C., mol. ratio. = *c.* 1 : 5). 391(3), 497(4), 629(4), 887(2), 984(3), 1066(3), 1449(3*b*), 2907(4), 2970(10), 3047(5).

C_2H_5OH . . . HCl ($t = -75°$ C., mol. ratio = 1 : 2·1). 398(3), 507(2), 613(2), 646(2), 873(3), 1021(3), 1094(2), 1281(2), 1348(3). 1450(6), 2928(8), 2977(10), 3357(1).

C_2H_5OH . . . HBr ($t = -65°$ C., mol. ratio = *c.* 1 : 5). 431(2), 520(4), 597(4), 708(2), 829(5*b*), 925(1), 1048(2), 1290(1), 1377(2), 1450(6), 2940(8), 2984(10).

$(CH_3)_2O$ . . . HCl ($t = -80°$ C., mol. ratio = 1 : 2·5). 356(1), 432(3), 506(3), 890(7*ab*), 947(1), 1006(1), 1083(3), 1444(8*b*), 2828(6), 2928(10), 3002(9).

$(CH_3)_2O$ . . . HBr ($t = -32°$ C., mol. ratio = 1 : 1·7). 268, 395(6), 506(2), 824(7*b*), 896(2), 965(1), 1023(1), 1440(8*b*), 2834(4*b*), 2948(10*b*), 3037(9*b*).

$(C_2H_5)_2O$ . . . HCl ($t = -80°$ C., mol. ratio = 1 : 3·5). 327(1), 418(3), 491(3), 787(2), 823(2*b*), 955(2), 997(3), [1058(1)], 1270(3), 1450(7), 2878(1), 2942(10), 2981(10).

$(C_2H_5)_2O$ . . . HBr ($t = -43°$ C., mol. ratio = 1 : 2·5). 303(1), 405(5), 470(1), 673(1*ab*), 830(0), 920(0), 996(4*b*), 1071(1), 1137(0), 1263(1), 1459(6b), 2866(0), 2940(10), 2984(10).

The detailed discussion of the spectra led to the conclusion that the compounds do not exist in solution of excess hydrogen halide as 'oxonium' compounds $\left(\genfrac{}{}{0pt}{}{R}{R} O H\right)^+ X^-$, but as compounds with tetravalent oxygen. We propose calling this type of compound an 'oxan' compound.

The question whether the former addition compounds appear as oxonium or oxan compounds is to a high degree dependent on the physico-chemical conditions (temperature, state of aggregation, solvent, etc.). By varying the conditions, a gradual transition from the 'oxonium' to the 'oxan' form is possible. It is not improbable that equilibria exist between the two above-mentioned extreme types. We have started a more intensive examination of this question.

A detailed account of the Raman investigations, as summarized above, will be published in the *Zeitschrift für physikalische Chemie* (*B*).

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Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces

THE adsorption isothermals of benzene and methyl alcohol vapours at the surface of mica are of sigmoid form, concave to the pressure axis until the first monolayer is nearing completion, and thereafter becoming more and more steeply inclined to it as saturation is approached. Though the adsorption energy decreases on completion of the first monolayer to a value very near the normal heat of liquefaction, the polymolecular films formed at saturation have properties quite different from the bulk liquids. This is strikingly demonstrated in a series of experiments we have recently carried out, a few of which are briefly recorded in this note.

When a freshly split mica plate is placed under a jet of the supersaturated vapour of benzene, methyl alcohol or water, condensation of bulk liquid does not occur until a film of critical thickness has been built up. By suitably controlling the conditions, films of thickness less than this, *yet thick enough to show interference colours*, are readily produced. A drop of the same liquid, placed on such a film, may flatten, but does not lose its identity as a lens, showing that the angle of contact, though small, is finite. Methyl alcohol, which spreads rapidly on fresh mica in the open air, will not do so in the presence of its own supersaturated vapour; on the contrary, a spread film was found to break up into drops when brought under the vapour jet. The alternative view as to the origin of the film colours, namely, that they may be due to diffraction from a mist of invisible droplets, is not borne out by the facts; for example, we were able to float lenses of different liquids right across the films without disturbing them in any way.

Much evidence has been found by us in favour of Hardy's view[1] that a drop of pure liquid placed on a clean solid surface invariably reaches a stable state only when a single lens is in equilibrium with an adsorbed film. Without permitting ourselves this degree of generality, we would emphasize the marked sensitiveness of the contact angle to changes in the degree of saturation of the vapour phase, and to the presence therein of even traces of a second adsorbable component; both these effects are often neglected in making measurements of contact angles.

Interesting effects are produced by placing drops of different liquids near each other on a mica plate, and these are at least rendered less incomprehensible by the realization that adsorbed films can be thick, and that the energy relations at the edge of a drop are markedly dependent on the *local* concentration of the second component of the film. If a drop of concentrated acetic acid, containing enough water to prevent its spreading, is placed near one of the very dilute acid (or of water) resting on clean mica, the former first elongates, then advances towards the dilute acid. Before contact, however, the latter drop is sharply repelled and driven forward to the edge of the plate. Arriving there, it is usually repelled by the edge, with the result that it dodges round its pursuer (which is attracted to the edge and remains clinging there), and comes to rest in the centre of the plate. A similar behaviour has been observed with other pairs of liquids, though the 'edge' effect is often less noticeable; for example, a lens of *n*-hexane will drive one of benzene in front of it until the former has all evaporated.

The highly convex lenses formed by hexane drops on mica spread immediately when brought under the jet of benzene vapour, whilst *lenses* of benzene condense on the spread film. The incomplete miscibility of hexane and benzene in the form of drops on mica is astonishing, though numerous other examples might be quoted. If a drop of hexane is placed on top of one of benzene as it rests on mica, the mixture divides itself into two parts—a spread film which quickly evaporates, showing interference colours, and a lens (mainly of benzene) which is repelled rapidly to the edge of this film. The possible application of such phenomena as a means of effecting separations immediately suggests itself. The drops used in these experiments must of course be small.

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Reliability of Pacific Seismological Stations

IN a former paper I gave a comparison of the accuracies of seismological stations, based on the residuals for *P* in the International Seismological Summary[1]. The fraction of the residuals between ± 4*s* was taken as the standard and called the 'reliability'. It came out rather low for most of the Pacific stations, though I suggested that the estimates might be too low, on account of errors in the epicentres due to too little weight having been given to the near stations. In some work on southern earthquakes, preparatory to a further study of the core waves, I have re-determined a large number of Pacific epicentres (up to the end of 1931), taking into account the effects of the ellipticity of the earth; the result is a great improvement in the reliabilities. They are now as follows:

Riverview, 17/17 = 1·0; Melbourne, 14/16 = 0·9; Apia, 8/10 = 0·8; Adelaide, 11/16 = 0·7 (probably too low as distant earthquakes give 11/12 = 0·9); Manila and Wellington, 13/17 = 0·8; Christchurch, 8/11 = 0·7; Amboina, 10/15 = 0·7; Batavia, 11/16 = 0·7; Honolulu, Perth and Malabar, 0·5; Sydney, 0·4; the rest, nearly as before.

Most of the change is due to the correction for the ellipticity of the earth, provided by Bullen[2]. At large distances this varies with azimuth by nearly 5 seconds when geographical co-ordinates are used, and introduces a large systematic error into southern epicentres if it is not allowed for. Bullen and I found on determining epicentres from the nearer stations[3], that southern earthquakes habitually showed negative residuals of about −4*s*. at great distances, and attributed these to slight focal depth; it appears now, however, that they were entirely due to the ellipticity. The great majority of Pacific earthquakes can be taken as having foci at an inappreciable depth.

The law of error in seismological observations seems to be practically the normal law with a uniform distribution superposed. The standard error corresponding to the normal part is found to be 2·0*s*. both for the good and for the intermediate stations; the difference between them is not in the accuracy of the normal observations, but in the frequency of defective ones, usually attributable to microseisms and weak beginnings.

There appears to be a slight difference between Pacific and continental travel times, amounting to about 2*s*. for *P*. between 5° and 50° out of a total time of 8 minutes, and indicating a higher velocity below the Pacific. This might be expected if there has been more cooling below the oceans than under the continents. Larger differences have been claimed previously, of the order of 10 per cent, but these are rendered impossible by the observations now available.

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[1] *Mon. Not. Roy. Ast. Soc., Geophys. Supp.*, 3, 423-443 (1936).

[2] *Mon. Not. Roy. Ast. Soc., Geophys. Supp.*, 4, 143-157 (1937).

[3] *Bur. Centr. Seism. Trav. Sci.*, 11 (1935).

Magnetic Quality of Nickel Wire as Influenced by the Surface

IN a previous note[1], test data were given which showed the very large increase of magnetic permeability of nickel wire which could be obtained by applying to the surface a thin skin of copper and allowing it to soak for some hours at a sufficiently high temperature.

The influence of the surface of a wire on its magnetic quality has been examined further as follows:

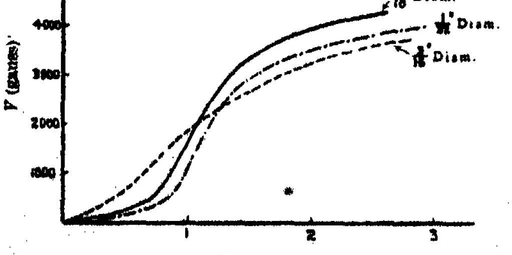

Fig. 1.

Commercially pure nickel wires of diameters 1/32 in., 1/16 in., and 3/16 in. respectively, were heated in an atmosphere of hydrogen for a sufficiently long time to reach a condition of maximum permeability in each case. After having cooled slowly to room temperature, the magnetization curves for each wire was obtained and these curves are shown in Fig. 1.

It will be seen that the initial portion of the curve for the 1/32-in. diameter wire is very flat and this part of the curve becomes steeper as the diameter increases. That is to say, the greater the ratio of surface perimeter to cross-sectional area, the less easily is the wire magnetized for low values of H. In other words, the magnetic characteristic of the wire is intimately dependent upon the diameter. The tests have also shown that the remanence and the coercive force are both considerably greater for the wire of 1/32 in. diameter than for the other wires.

These results have important theoretical and practical implications, which will be considered in a paper which is now in course of preparation for publication elsewhere.

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[1] NATURE, 139, 928 (May 29, 1937).

Darkening of some Commercial Titanium Dioxide in Daylight

DURING an investigation of the discoloration by light of some ceramic glazes containing titanium compounds and of the subsequent fading of the discoloration when the glaze is kept in the dark[1], it was observed that certain varieties of commercial titanium dioxide are themselves affected by daylight. These varieties pass from their normal creamy colour to a deeper yellow-brown tint on exposure. The original colour is restored in the dark. This property of some commercial titania appears to have escaped notice in Great Britain, though Lee[2], in his study of reversible photo-sensitivity in hackmanite, draws an analogy with a certain brand of titania which showed the property mentioned in this letter.

The samples of titanium dioxide studied were stored in ordinary glass vessels exposed to daylight transmitted through the glass of the laboratory windows. The darkening of the titania, observed against samples kept in the dark, was apparent after only three hours in some instances. The effect is shown by those particles or perhaps portions of particle-surfaces adjacent to the illuminated glass wall of the container. Hence it is important that the powdered titania should move as little as possible during illumination if the darkening is to be obvious.

No experiments were made with the photo-sensitive brands of titania as components of paints or pigments, but they conferred similar properties on some ceramic glazes containing them. However, ceramic glazes darkening in light were made from titania and from rutile where these materials themselves showed no apparent darkening.

A definite explanation of the darkening of titania cannot be cited, though it appears likely that the colours shown by the exposed and by the unexposed material mark the establishment of an equilibrium condition of either a chemical or a physical nature. A chemical explanation might involve the oxidation of ferrous iron present in the titania to a more deeply coloured ferric compound (cf. the possible mechanism for the darkening effect of titania on the colour produced by iron in enamels[3]). Titania is a source of photo-activation of chemical processes, including some oxidation processes[4]. Less likely is a change in the state of oxidation of the titania itself. (Renz discusses the reduction of titania in light in the presence of certain organic liquids and reducing solutions[5].) Among physical explanations, changes in the crystalline variety of titania present (cf. the crystalline phases known to mineralogists as rutile, anatase and brookite) or in the grain-size of the titania do not seem very probable. Alteration in the degree of dispersion of some colloidal material suspended in the titania is another possibility (see, for example, the summary of Doelter's work given by Lee[2] and the references provided by Clarke[6]).

The above suggestions are by no means exhaustive, and the possibility of a connexion between the darkening of some titanium dioxide by light and the darkening of titania on heating should be borne in mind. Meanwhile, notice of the phenomena described may be of value to those workers interested in titanium and its compounds.

I wish to thank Dr. Harry W. Webb for reading through this letter.

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A New Form of Resorcinol

A NEW form of resorcinol has recently been investigated in this Laboratory which compares as follows with the structure already described by Robertson[1].

	α-Resorcinol	β-Resorcinol (new form)
space group	C_{2v}^{9} (*Pna*)	C_{2v}^{9} (*Pna*)
axes : *a*	10·53	7·91
b	9·53	12·57
c	5·66	5·50
cell volume	568 A.^{3}	547 A.^{3}
molecules per cell	4	4
molecular symmetry	none	none
calculated density	1·278	1·327

The principal intensities and higher orders of single crystal X-ray photographs show that the molecules in the β-crystals have turned round to align themselves in the *b*-axis direction.

The new form is conveniently prepared by slow evaporation of benzene solutions at ordinary temperatures, using specially dried air[2]. Vacuum sublimation of resorcinol under certain conditions gives a preponderance of β-crystals, in large shiny flakes, which can easily be distinguished from the long needles of the α-form. According to Lautz[3], resorcinol undergoes a transformation above 70·8° C. into a denser modification, which is perhaps identical with the β-form.

The two forms of resorcinol are of considerable interest for the theory of intermolecular resonance, since the hydroxyl 'bonds' in the two structures need not necessarily be of the same length. Although this point can only be decided by a quantitative measurement of intensities of reflection, the manner of discovery of the β-form suggests that a difference in the hydroxyl bonds is quite possible. Repeated crystallization of resorcinol from 99·6 per cent 'heavy' water gives a deutero-resorcinol which, according to Munzberg[4], has the structure $C_6H_2D_2(OD)_2$. Whereas $C_6H_4(OH)_2$ when crystallized from boiling benzene gives good crystals of the α-form, the deuterium compound gives poor feathery crystals of the β-form; in one case a crystal was obtained which had the α-structure at one end and the β-structure at the other. On vacuum sublimation, $C_6H_2D_2(OD)_2$ again behaves differently in giving a preponderance of crystals with the α-structure.

The thermodynamic relationship between the two forms and their magnetic anisotropy are being measured. The possibility of a transformation from one form to the other in the solid should perhaps be considered in connexion with temperature effects described by Nilakantan[5].

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Carbon-Halogen Distance in the Methyl Halides

IN attempting to correlate the data on interatomic distances in polyatomic molecules, certain serious discrepancies have come to light between the spectroscopic method and the diffraction method as regards the carbon-halogen distances in the methyl halides. The differences are tabulated in Table 1. The reason that this had not been noticed earlier is that certain mistakes have been present in the deductions from the spectroscopic data and also that many new data are available. These results are particularly interesting when compared with the corresponding distances in the carbon tetrahalides, which are given in the last column. Thus it will be seen that, according to the diffraction method, in the methyl halides the carbon-halogen distance is always greater than, or equal to, the corresponding distance in the tetrahalides, whereas the spectroscopic method would seem to indicate that exactly the opposite is the case. The latter seems much more likely from consideration of the mutual repulsion of the halogen atoms in the tetrahalides.

TABLE 1.

	Old spectroscopic value[1]	New spectroscopic value	Diffraction value[2]	Value in CX_4[3]
CH_3F	1·4	1·385 ± 0·004	1·42 ± 0·02	1·36 ± 0·02
CH_3Cl	1·8	1·66 ± 0·05	1·77 ± 0·02	1·755 ± 0·005
CH_3Br	2·0	1·88 ± 0·08	2·06 ± 0·05	1·93 ± 0·03
CH_3I	2·05	2·12 ± 0·15	2·28 ± 0·05	—

Further support for this interpretation comes from an examination of the force constants for the C-halogen bond in the two cases. These are compared in Table 2, where it will be noticed that the force constant is always considerably larger in the methyl halide than in the tetrahalide. The force constants in the first column were obtained by the method of Sutherland and Dennison[3], while those in the second were obtained by that of Urey and Bradley[4].

TABLE 2.
Carbon-halogen force constants in 10^5 dynes/cm.

	C—F	C—Cl	C—Br
CH_3X	5·8	3·6	2·9
CX_4	4·0	1·8	1·4

One may not convert this difference in force constant into a difference in internuclear distance directly by means of the Clark[5] or the Badger[6] relation, since the bonds are under considerable strain in the tetrahalides. Badger, however, has shown how it is possible to make an allowance for this and has actually predicted a difference of 0.19 A. between the C—Cl distance in CH_3Cl and CCl_4. This is of the same order as that found above.

Duchesne[7], and Linnett and Thompson[8] have recently remarked on the apparent large change in the C—C force constant in going from C_2H_4 to C_2Cl_4, and have suggested interpretations involving resonance between different structures. It seems probable, however, that at least a part of this change is due to the C—C bond being under a strain in C_2Cl_4 from the mutual repulsions of the Cl atoms. The potential functions used by Duchesne took no account of interaction between the Cl atoms.

A full treatment of these matters will be published in due course.

G. B. B. M. SUTHERLAND.

Pembroke College,
Cambridge.
July 9.

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Œstrogenic Substances in the Dead Sea

THE Dead Sea, situated at one of the deepest points of the earth, contains a high concentration of salts (more than 25 per cent). In the depth of the Dead Sea there is a sandy mud which we have found to exhibit a certain œstrogenic activity. For the mud of the southern part of the Dead Sea the œstrogenic activity is about three times as great as for the northern part. The deep sea water contains 100 M.U. per litre, while the surface water is free of œstrogenic substances. The salt manufactured from the Dead Sea (salsana) contains 100 M.U. per kgm. Our results are given in the following table.

Part of the Dead Sea	Depth	Hormone activity (M.U. per litre)
A. Water.		
North near Kallia	Surface	Less than 6·6
" " "	Near the bottom	100
South	Surface	Less than 20
B. Mud	M.U. per kgm.	M.U. per kgm. dry weight
North near Kallia	80	45
South	100	100
C. Salsana		100

Other steroid hormones (male sex hormone, progesterone) could not be detected.

The mud was found to contain a yellow dye-stuff which according to its physical properties (absorption and fluorescence spectra *inter al.*) belongs to the lyochrome group.

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Maturation in the Thelytokously Parthenogenetic Tenthredinidæ

SINCE Doncaster's preliminary work in 1906[1], nothing has been recorded on the maturation of the thelytokously parthenogenetic Tenthredinidæ. This author concluded that the chromosome number in the oocyte, polar nuclei and egg pronucleus was 8, and that there were two maturation divisions giving rise to an egg pronucleus and three polar nuclei[2]. Recent work on the species *Pristiphora pallipes* Lep., by our colleague, Mr. L. C. Comrie, raises strong doubts regarding Doncaster's interpretations on chromosome number and behaviour, but confirms him regarding the number of maturation divisions and polar nuclei.

In the thelytokously parthenogenetic species *Thrinax macula* Kl., we find that in the female-producing egg there occurs only one maturation division, non-reductional, with the formation of one polar nucleus. Evidently there exist different methods of maturation in the thelytokously parthenogenetic saw-flies.

Doncaster's species are thelytokous, with rare males, whilst *Thrinax macula* reproduces by obligatory parthenogenesis (in the laboratory at least), though certain females parthenogenetically produce all-male (or almost all-male) broods, such males being found reproductively useless.

The female chromosome constitution is $2n = 14$, that of the male possibly $n = 7$. Good oogonial figures, not easily obtained, show 12–16. Chromosomes of the maturation spindle at no time exhibit tetrad formation; each of the 14 chromosomes is split longitudinally; 14 travel to each pole, arranged, very often, temporarily as 7 couples. Two vesicles are formed, the inner sinking into the yolk without further maturation.

The polocyte is either extruded or it divides on a wide asterless spindle and displays clearly 14 large rod-shaped chromosomes split longitudinally. The outer group derived from this division is extruded from the egg, but the inner group becomes vesicular, may undergo a further division, and ultimately degenerate.

Embryonic tissues show approximately 12–14 very small chromosomes. Follicle cells from pupal ovaries best show the number (14), morphology and arrangement of the chromosomes. Corroborative counts from other tissues are obtainable during metamorphosis, though polyploid spindles are more common, especially in tracheal and gut cells.

Spermatogonia have not been obtained. The first spermatocyte division is abortive and a minute cytoplasmic polar bud is nipped off. The second spermatocyte with 7 chromosomes produces two spermatids each with 7 chromosomes. In several cases were seen whole cysts of cells with 7 loosely arranged pairs of chromosomes; we interpret them provisionally as 7 split chromosomes of the first spermatocytes preparing for the second (equational) division. The cytology of male maturation and spermateleosis therefore closely resembles that typical of Hymenoptera.

Attention is directed to these considerations regarding *T. macula*: (1) In our experience the chromosome number of 14 is very exceptional among saw-flies, for some 40 species studied by ourselves and our colleague, Dr. F. Greenshields, show that 16 is usual (possibly it is 12 in a species of *Claudius*). (2) Its autoregulation behaviour is 'orthodox', for such occurs in the majority of animals thelytokously parthenogenetic. (3) It is uncertain whether the female chromosome constitution (14) is double that of the male, though the count of 7 in the male spermatocyte supports this view.

Our conclusions have been reached from intensive study of abundant material. The usual fixatives were used, but Petrunkewitsch gave the best result with eggs; for the most part we stained with iron hæmatoxylin, but gentian violet, safranin and Fuelgen's reagent gave good results.

This work has been done with the assistance of a grant from the Department of Scientific and Industrial Research and whilst one of us (A.R.S.) is a teaching fellow under the Carnegie Trust. To both these bodies we give our thanks.

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July 10.

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[2] Doncaster, L., *Quart. J. Micro. Soc.*, **51** (1907).

Body Orientation in Crustacea

THERE is, I think, a fallacy which is frequently made in many of the problems dealing with the body orientation of Crustacea. I believe that practically all biologists dealing with this subject have accepted the idea that the position of the centre of gravity is a matter of great importance. Thus, to quote just one of the many statements which have been made along these lines: S. R. Williams[1] says, "A sinking animal, like a lifeless body, always falls with the heavy end downwards." Lifeless bodies do not sink with the heavy end downwards unless their specific gravity is considerably greater than the liquid in which they are sinking. Not only can this be demonstrated by experiment but also it is in agreement with standard text-book hydrodynamics.

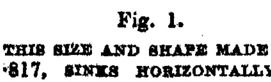

Fig. 1.

A CONE OF THIS SIZE AND SHAPE MADE OF ASH, SPEC. GRAVITY 0·817, SINKS HORIZONTALLY IN PETROL, SPEC. GRAVITY 0·74 AND RISES HORIZONTALLY IN A MIXTURE OF ALCOHOL AND WATER, SPEC. GRAVITY 0·95.

Recently I have made a series of cones of different materials (Fig. 1). In all cases the diameter at the base was a quarter of the length, but, in addition, the broad end of the cone was made hemispherical. The centre of gravity of the cone itself would, of course, be three quarters of the distance from the tip, while the hemispherical attachment would bring the centre of gravity still farther from the point. The cones were made of different kinds of wood, box, mahogany, ash and ebony while the liquids used were water, water and alcohol, petrol. Ash floats in water but sinks in petrol. Box just floats in tap-water but will sink after it has been soaked for several days. Another excellent material is the ordinary carrot, which will always sink slowly in tap-water. The size of the cones varied from half an inch in length to six inches. It is unnecessary for me to give the actual figures for the specific gravities here; suffice it to say that a cone of the shape figured either sinks or rises horizontally, although the position of the centre of gravity is very definitely towards the one end.

To get satisfactory results, the specific gravity of cone and liquid must be reasonably close, and it is much easier to obtain the horizontal position with small cones. Cones were made of zinc, tin, lead and iron, and any of these drop through tap-water with the heavy end first.

From the above experiments, it is, I think, definitely proved that provided the lifeless body sinking or rising is doing so in a liquid that approximates its own specific gravity, the position of the centre of gravity has very little influence. There is very little definite information about the actual specific gravity of living Entomostraca. Several attempts have been made to find it, but since these have all been made either with a dead or narcotized animal which was made to float in liquids of known specific gravity, the result can only be a rough approximation.

However, it is quite certain that in most cases the animals are just slightly heavier than the liquid in which they are swimming. According to Williams, the specific gravity of *Cyclops albidus* is 1·022 while that of *Cypridopsis vidua* Müller (an ostracod) is 1·046; since the specific gravity of any natural water must be above 1·0, it is fairly clear that an additional spine or a slight increase in the extension of the head of a *Daphnia* cannot affect body orientation by influencing the position of the centre of gravity.

This is scarcely the place to discuss the somewhat voluminous literature on the subject, but the position of the centre of gravity plays a very large part in Woltereck's theory[2], which has been discussed somewhat fully by Skogsberg[3] and accepted. It has also been accepted by Wagler[4]. From the mathematical point of view (I am greatly indebted to one of my colleagues, Mr. H. C. Nest, for looking up this theorem for me) the matter is treated fully by Ramsey in "A Treatise on Hydromechanics", Part 2: "Hydrodynamics", p. 196, "Stability". At the end of the theorem it is stated that "this accords with the observed tendency of a body to turn its flat side or its length across the direction of its motion".

To put the matter more crudely: when a body is sinking through a liquid, the most stable position is one in which it presents the greatest area in the horizontal plane. In other words, there is a very definite tendency which brings the greatest possible plane into the horizontal position; but if the speed of sinking is at all great, other factors may influence the attitude taken up by the sinking bodies. Small Entomostraca, even though the specific gravity of chitin may be as high as 1·4, are incapable of sinking rapidly. Actually the chitinous casts of Daphnids sink quite slowly; so do those of freshwater ostracods.

The swimming, floating and sinking of these minute crustaceans at present constitutes an almost impossible problem, and it depends, I believe, entirely on the nature of the eddies and vortices set up. Mere speculations, though they may be very attractive, are not likely to carry one very far; but I think one can safely conclude that with organisms comparable in size and specific gravity to *Daphnia* or *Chirocephalus* the position of the centre of gravity plays no part whatsoever as a factor determining body orientation.

A. G. LOWNDES.

Marlborough College,
Wilts. June 16.

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Points from Foregoing Letters

Prof. I. M. Heilbron, A. E. Gillam and Drs. E. Lederer and V. Rosanova have spectrographically examined the liver oils and vitamin A concentrates from more than sixty batches of seven different species of freshwater fish, and find that the main absorption bands are at 693 mμ (and inflection 620 mμ) for chloroformic antimony trichloride, and 345 mμ for alcohol. These properties are in contrast to those of marine fish and mammalian liver oils and concentrates, where the corresponding maxima are 620 and 328 mμ respectively, and may possibly be due to a second vitamin A with some degree of specificity for freshwater fish.

A substance with absorption bands at 350 and 287 mμ, giving a green colour with antimony trichloride ($\lambda_{max.}$ 693 mμ), is stated by Drs. J. R. Edisbury and R. A. Morton, and G. W. Simpkins to appear in the liver, viscera and sometimes eyes of fish, particularly freshwater fish. It resembles vitamin A so closely that it is tentatively designated 'vitamin A_2'.

F. W. Fox and W. Stone state that a substance other than ascorbic acid and having no antiscorbutic activity is formed in large quantities in Kaffir beer. It behaves as ascorbic acid with indophenol at a *p*H higher than 2·0, with the folin uric acid reagent, and with ascorbic acid oxidase. It does not react as ascorbic acid with norite charcoal or with indophenol at a *p*H between 1·2 and 1·8.

Theoretical curves for the absorption of the soft component of cosmic radiation by lead and aluminium have been calculated by Dr. W. Heitler on the basis of the quantum theory. The few available values from experimental measurements fall satisfactorily on these curves.

F. Hoyle states that, to account for the result of Jacobsen's recent experiments, it is necessary to assume a β-decay interaction term which combines the wave-functions of the heavy and light particles in a more interrelated form than the expressions proposed by Fermi and Konopinski-Uhlenbeck. This modification makes more definite predictions of the low-energy end of positron and electron spectra, which seem to give reasonable agreement with the empirical β-decay curves.

From the Raman spectra of solutions of ethyl ether in excess halogen acids, Dr. G. Briegleb and W. Lauppe conclude that, in solution, they form 'oxan' compounds containing tetravalent oxygen.

By directing jets of supersaturated vapours of common liquids against surfaces of mica, Prof. D. H. Bangham, S. Mosallam and Z. Saweris have produced films which give rise to interference colours, and yet have properties very different from the bulk liquids; these they regard as thick adsorbed films.

Taking into account the ellipticity of the earth, Dr. Harold Jeffreys has redetermined a large number of epicentres of Pacific earthquakes, and finds great improvement in the reliability of Pacific seismological stations.

Further experiments by Dr. T. F. Wall on the influence of surface treatment on magnetic properties show that nickel wires, heated in hydrogen and then cooled (for low values of the magnetic field strength), the greater the ratio of the surface perimeter to the cross sectional area, that is, the smaller the diameter, the less easily magnetized they are. An increase in the coercive force and in the remanence is likewise observed as the diameter decreases.

W. O. Williamson directs attention to the reversible darkening of some commercial titanium dioxide under the influence of light, and indicates a number of possible explanations.

A new crystal form of resorcinol is described by A. R. Ubbelohde and Dr. J. Monteath Robertson. This resembles the beta form of the tetradeuteroresorcinol crystals, and the authors suggest that there is a difference in the hydroxyl bonds in the two crystal forms, due to a difference in the intermolecular resonance.

The distance between the carbon and the halogen atoms in the methyl halides, recalculated from the spectroscopic data by Dr. G. B. B. M. Sutherland, are markedly smaller than the previously accepted ones and those obtained by the method of electron diffraction. The revised values appear the more likely to be correct on comparison with the corresponding distances in the carbon tetrahalides and with the force constants for the carbon-halogen bond in the two cases.

Prof. A. D. Peacock and Dr. Ann R. Sanderson find in the thelytokously parthenogenetic saw-fly, *Thrinax macula*, that the female chromosome constitution is $2n = 14$, that of the rare male (from second spermatocytes) $n = 7$, and that there is only one maturation division, non-reductional, in oogenesis. The work of Doncaster and of Comrie with other species of thelytokously parthenogenetic saw-flies shows two maturation divisions in oogenesis, and Peacock, Sanderson and Greenshields find that the female chromosome constitution in some 40 species of saw-flies is $2n = 16$. Accordingly, autoregulation of chromosome number in saw-flies is maintained by at least two methods, whilst *T. macula* is exceptional in its chromosome constitution.

Research Items

The Oolitic Limestone Escarpment in Bronze Age France

Miss Margaret Dunlop, in a study of the significance of the Oolitic limestone escarpment in the Bronze Age in France (*Man*, July 1937), points out that the grouping of Bronze Age finds in France is such that it is possible to discern three types of environment—maritime, riverine and plateau. In the cooler, wetter conditions of the Middle Bronze Age in the ninth century B.C. the forest-tree plateau, and the Oolitic limestone ridges in particular, are significant in the distribution of certain objects of material culture. They form a natural region imposing topographic restrictions on those using them, and may be said to be a distinct, though secondary, cultural province in the life of Bronze Age France and a feature of vital importance in the maintenance of exchange and some semblance of organization during the unsettled conditions of the Hallstatt phase of readjustment. The major Bronze and Early Iron Age cultural spreads affecting the French Oolite are as follows: *c.* 1750 B.C., an infiltration from the Rhine Valley and south Germany, characterized by the large broad triangular dagger and the flanged axe; (Jura, Dauphiné, down Rhone, etc.); *c.* 1400 B.C., invasion from south Germany and Bohemia—dagger with blade with two rivets, simple sword (Jura, Charente, south to Gard and Puy de Dome, tumuli of Côte d'Or and Jura, Herault); *c.* 1200 B.C., invasion and infiltration from north European plain—riveted pistiliform sword, winged lance with eyelet holes, terminal winged axe (Aube, Marne, S. Brittany); *c.* 850 B.C., first Hallstatt invasion from south Germany and western Austria—short bronze sword (Oolitic outcrop, eastern tumuli); *c.* 600 B.C., renewed invasions from same sources—iron sword with bronze rivets, hilt terminating in double circle (distributed as in previous period, concentration around iron mines of Chatillonais, north of Côte d'Or).

Extinct Mammals and Man in America

Further evidence relating to the contemporary existence of man and an extinct mammalian fauna was obtained in pluvial deposits near Clovis, New Mexico, in the course of 1936. An account of the results of the work of the expedition, which was under the direction of Dr. E. B. Howard, acting on behalf of the Philadelphia Academy of Natural Sciences, has been prepared by Mr. John Lambert Cotter (*Proc. Acad. Nat. Sci. Philadelphia*, 89). The site under investigation was that known as "the gravel pit" in Blackwater Draw, between Portales and Clovis. The stratigraphy of the pit is characterized by the occurrence of three more or less distinct layers, aggregating approximately seven feet: first, brownish sand, extending two and a half feet from the surface; second, a bluish material containing sand, grit and clay, three feet; third, a speckled sand, one and a half feet thick. The blue stratum and the speckled sand were found to contain certain bone remains, with which were associated two Folsom-like points, a fragmentary point, a scraper, several flakes, all of chalcedony, and two bone artefacts, such as have not previously been associated with a Folsom industry. The occurrence of the bones resolves itself into certain characteristics: the bones of the bison, except for a cannon bone and a scapula, occurred in the blue material immediately above the mammoth. The mammoth bones occupied the contact between the blue material and the speckled sand. Below the mammoth bones in the speckled sand were horse bones and traces of turtle-shells, thirteen inches below the contact of blue material and speckled sand. The lithic and bone artefacts were in definite association and contemporaneous with the mammoth bones. The bone artefacts show bevelled surfaces at their ends, which are compared with the splicing technique of the Eskimo and Indians of North America.

The Hæmorrhagic States

The hæmorrhagic states were the subject of a discussion at a combined meeting of the Sections of Medicine and Pathology, Bacteriology and Immunology of the British Medical Association at its recent meeting in Belfast. Prof. L. J. Witts delivered the opening paper. He said that these conditions did not lend themselves to rigid classification. In the treatment of hæmophilia, the local application of coagulant snake venoms was an important advance, but liver extract, œstrin and moccasin venom had been failures. For the idiopathic thrombocytopenic purpura removal of the spleen was the most successful treatment, but its mode of action was uncertain. Vitamin C was of value in scurvy only, and not in other hæmorrhagic states. Dr. Capon discussed hæmorrhagic conditions occurring occasionally in the newborn (about one in 400 cases) and found that the majority were relieved by an intramuscular injection of whole blood. Dr. Timperley maintained that an extract of egg-white, prepared by his special method, controlled internal hæmorrhage in hæmorrhagic states, but its efficiency was not confirmed by other speakers.

Grass-drying

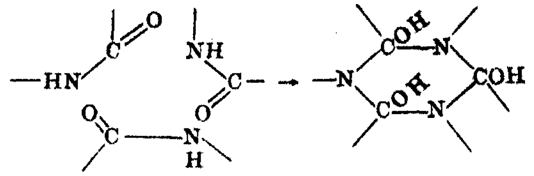
Since the Agricultural Research Council issued its first report in 1935 on the preservation of grass and other fodder crops, much new information on the subject has been obtained and considerable advances made. While fewer than a dozen driers were in use in Great Britain during 1935, nearly fifty were at work in 1936. A survey of the problems connected with grass-drying and its effect on the economy and management of farms has been made by E. J. Roberts, and published as a report entitled "Grass Drying" to the Committee of the Council (London: H.M. Stationery Office. 2*s.* net). An introductory chapter describes the different methods of preserving grass, while others follow which deal with the extent of the grass-drying movement, the production of suitable herbage, the water content of the herbage, cutting and hauling, furnaces, fuels and power, grass-drying machines and the feeding value of young grass. In the concluding chapter, the cost and profitableness of producing dried young grass are considered. Drying only becomes worth while if the special nutritive qualities of young grass can be conserved, and in wet seasons when growth is so rapid that the drier cannot deal with all the produce, definite areas should be devoted to hay-making or ensiling. The collection of short young grass originally offered some difficulty, but machines have now been devised which overcome this. The cost of production of dried grass in 1936 varied considerably on different farms; but the average figure, allowing for rent, overhead expenses and depreciation, was about £6 per ton, a figure which at the present price of concentrated feeding stuff allows a margin on true nutrient values. The chief obstacle to an extension of the process is the high capital cost of driers; but doubtless these will be lowered as experience is gained, and the enthusiasm shown both by the farmers and by the manufacturers of driers will go far to overcome the difficulties at present encountered.

The Soviet North Polar Station

REPORTS received in Moscow by radiogram from the floating observatory in the vicinity of the North Pole and supplied by the Soviet Union Year Book Press Service have already announced some results of interest. In lat. 88° 54′ N. long. 21° W. the depth of the Arctic Ocean was found to be 2,345 fathoms (4,290 metres) and in lat. 88° 47′ N., long. 10° W. 2,391 fathoms (4,374 metres). These readings compare with Peary's 1,500 fathoms (2,743 metres), no bottom, within five miles of the Pole and Amundsen's 2,050 fathoms (3,750 metres) in lat. 87° 43′ N., long. 10° 21′ W. Since the station is steadily drifting farther important soundings may be expected. In relation to Wilkins's sounding of 2,974 fathoms (5,440 metres) in lat. 77° 45′ N., long. 175° W., it would appear that the deepest parts of the arctic basin occur in the Beaufort Sea and adjoining the wide Asiatic continental shelf. Another discovery of importance is the occurrence of a layer of water at a depth of 275–600 metres with a temperature above 0° C. and a high salinity. This would appear to be the Atlantic water which Nansen discovered to be sinking, in the Spitsbergen area, below the colder and less saline polar water. Lastly, plankton determinations show a much more abundant pelagic life than had been anticipated.

Patterns of Proteins

IN a recent paper (*Proc. Roy. Soc.*, A, **160**, 59; 1937), Dr. D. M. Wrinch presents a reasoned account of her theory of the molecular constitution of proteins. This is an attempt to provide a unitary explanation of three characters common to all soluble proteins: (*a*) The molecules are largely made up of amino- and imino-acid molecules. They contain peptide linkages but few free NH_2 groups. (*b*) There is a general uniformity among proteins of widely different chemical composition. (*c*) A large number of crystalline proteins have highly symmetrical crystals. These properties she claims to explain on the basis of higher order polymerization of amino-acids. The simple peptide link can only give rise to rings or chains of amino-acids. To get more complex aggregates it is necessary for each molecule to be linked to three or four others. This can be done by an inner transformation according to the scheme:



On the basis of this transformation, it is possible to build up trigonal plane groups of different stages of complexity. These 'cyclol' sheets have, owing to the fact that all the amino-acids are of the α type—an observation which here, it is claimed, obtains significance for the first time—have all their side chains on one side of the plane. They can further be attached together either by means of these side groups or by hydroxyl bonds, thus forming larger aggregates, which must necessarily be integral multiples of the smallest of them, as Svedberg had found. Owing to their unsymmetrical character, such cyclol plates will be surface-active and the hypothetical structure gives a good agreement for the surface densities of protein films. Owing to the great complexity of protein chemistry, it may be long before it is possible to verify any of these hypotheses, but it must be admitted that the solution offered, although it contains arbitrary elements, is both simple and elegant.

Observation of a Fireball Train

IN a recent paper (*J. Brit. Astro. Assoc.*, **47**, 7; May 1937), Mr. M. A. Ellison describes a fireball observed on March 21 about $19^{h}\ 02^{m}$ U.T. The brightness was greater than that of Venus, and the colour was a golden-red. The most important point about this fireball was the velocity of the train. Mr. Ellison estimates that, at a height of 60 miles, the drift velocity was 133 miles per hour. From the configuration of the train, it is possible that the middle portion was subject to a current of even higher velocity than the ends. Many will be surprised at this velocity in the higher regions of the atmosphere, where it is believed that diffusion is a more potent factor in mixing the gases than currents of wind. If Mr. Ellison's figures be correct, it is obvious that the latter cannot be ignored in the stratosphere.

Aerodynamic and Electrodynamic Equations

N. P. KASTERIN (Report of Academy of Sciences, U.S.S.R., December 9, 1936) has attempted to account for many phenomena, usually explained by relativity or quantum mechanics, on a strictly classical basis, merely by adding small extra terms to Maxwell's electrodynamical equations. At the same time he adds similar terms to Euler's equation of hydrodynamics, and unites these two sets of equations into a common system. It is claimed that the new hydrodynamic equations, as applied to vortex motion of gases (which is of great importance in aviation) explains several well-known phenomena inexplicable by the old equations. As for the new form of Maxwell's equations, the extra terms are non-linear, and involve a variable velocity of light. It is stated that the quantum properties of the field can be deduced from this basis. The grounds for this assertion are not fully explained, but they appear to be connected with an analogy between moving tubes of force and gaseous vortices.

Validity of Laws of Electrodynamics

IN the course of an investigation carried out for an electrical engineering company, I found that some generally accepted laws of electrodynamics were incorrect, and that serious mistakes were therefore being made by electrical engineers. As the laws here referred to have been taught by such high authorities as Maxwell and Jeans, they are naturally being repeated in most of the text-books that are now used at our universities and technical colleges: in fact, one of these laws (which has already caused patents to be taken out for circuit breakers that will work in a very different way from what was expected, and *for electric motors that will not work at all*) is taught in all text-books that deal with the subject, including those used on the Continent and in America.

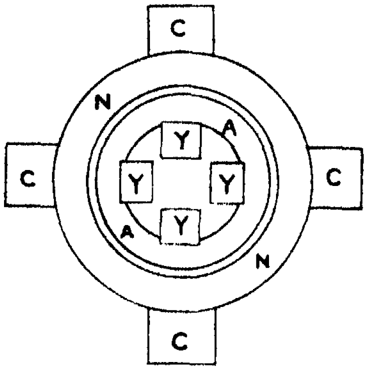


Fig. 1.

The law to which I have just referred is sometimes ascribed to Laplace, sometimes to Biot and Savart, sometimes to Ampère, and sometimes to Maxwell; but all teachers appear to regard that law as infallible. It may be stated as follows, though it is more frequently stated in a less complete form.

When a straight conductor element of length dx carries a current i in the OX direction of rectangular co-ordinates (right-handed) and lies in a magnetic field where the flux density has a component b in the OY direction, it is acted upon by a force $i.b.dx$ in the OZ direction.

The units here referred to are, of course, those of the C.G.S. system usually employed in text-books of electromagnetism. The current is accordingly in dekamperes and the force in dynes. In view of the doubt with regard to the name of the investigator by whom this law was first enunciated, I propose calling it 'the $i.b$ law'. This name seems appropriate, since the law says that $i.b$ is the force intensity (dynes per centimetre length of conductor) at the point in question.

But when the $i.b$ law is applied to the case shown in Fig. 1, which is an end-view of a direct-current slip-ring dynamo designed by Dr. A. E. Clayton, it tells us that the machine will work, though Dr. Clayton found that it would not. From his description of the machine, in the *Electrician* of July 2, 1915, it appears that he may not have designed it with the idea that it would work, but with the idea that its failure would disprove Faraday's law of electromagnetic induction. He evidently overlooked the fact that its failure has disproved the $i.b$ law; for he continued to teach this law, which is repeated in his latest books on dynamo design. But the following considerations will make it clear that the $i.b$ law has been conclusively disproved by the failure of this machine.

In *Fig.* 1, C, C, C, C are the ends of the straight iron cores upon which the field coils are wound, N is the ring-shaped north pole of the magnet, A is the ring-shaped core of the armature, and Y, Y, Y, Y are the ends of the straight iron yokes that connect this armature to a similar one at the south pole end and rotate with these armatures. All the rings here referred to were of rectangular cross-section, and the armatures were ring-wound on the parts between the yokes.

The machine should evidently work as a motor, according to the $i.b$ law, when the windings are suitably fed with direct current through the slip-rings; *for the conductors that are in the main flux* (between the armature cores and the magnet poles) should be subjected to a force much greater than any opposing force acting on conductors in the leakage flux, owing to the great permeance of the magnetic path in the iron yokes. Actually, however, the machine would not work; and this will be understood when attention is directed to the fact that the *amount of flux linking the winding would not begin* to change when the armature began to rotate, with the consequence that (according to Neumann's law) no back-e.m.f. would be generated.

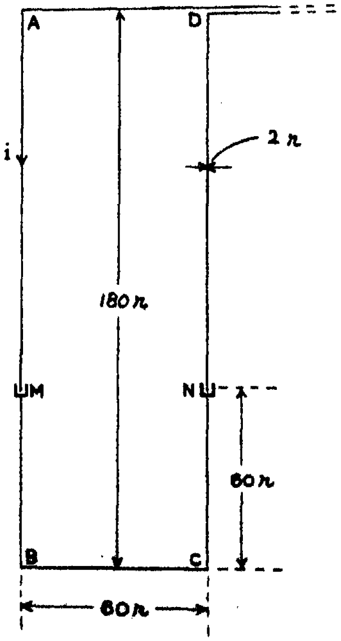


Fig. 2.

Dr. Clayton eventually came to the conclusion that his machine was a failure from every point of view: that is to say, it not only failed to work, but also (in his opinion) failed to give a disproof of Faraday's law. His present view is that Faraday's "lines of magnetic force" were rushing from yoke to yoke when the armature was rotating, cutting the inside conductors on their way, and thereby generating an e.m.f. that counterbalanced the one generated in the outer conductors. Many electrical engineers are unable to see any justification for this view; and Dr. Clayton will certainly find it useless as a defence of Faraday's law against the following argument.

Fig. 2 shows an experimental circuit-breaker arrangement, with mercury cups at M and N (where the arcs would be formed when the actual circuit breaker began to open). When this arrangement is surrounded by air, or by any other medium of unit permeability in the C.G.S. electromagnetic system, the amount of flux dc that is cut during a downward movement of $MBCN$ through the distance dy, with the current kept constant, can be calculated by methods explained in text-books of electromagnetism. It will thus be found that dc consists of a part

$$2\,i\,dy\,(0{\cdot}054 + 0{\cdot}161)$$

that comes from $MADN$ and is cut by BC, and a part

$$2\,i\,dy\,(0{\cdot}054 + 0{\cdot}030)$$

that comes from $MBCN$ and is pulled across AD, so that

$$dc = 0{\cdot}6\,i\,dy.$$

According to Maxwell (see Art. 541 of his "Treatise on Electricity and Magnetism"), the total amount of flux-cutting must be equal to the total increase in the flux that links the electric circuit. But when we try to verify this in the present case, by making a direct calculation of the extra flux linkage dk that is due to the downward movement of $MBCN$ through the distance dy, we get

$$dk = 17{\cdot}5\,i\,dy.$$

The great difference between dc and dk is accounted for by the fact that the stretching of AB and DC through the distance dy causes additional flux to be sent through the area $ABCD$ by the added lengths dy at M and N.

If $MBCN$ is moving downwards with a velocity of v centimetres per second, and if the movement through the distance dy takes place in the time dt, we have $dy/dt = v$, $dc/dt = 0{\cdot}6\,i\,v$, and $dk/dt = 17{\cdot}5\,i\,v$. The induced E.M.F. will therefore be $0{\cdot}6\,i\,v$ or $17{\cdot}5\,i\,v$, according to whether Faraday's law or Neumann's law is correct. To settle this question, I attached $MBCN$ to one end of a strip of wood that was arranged to turn about a knife-edge in the manner of the beam of a balance. This enabled me to measure the electromagnetic force F exerted on $MBCN$ when various currents (up to 1,300 amperes) were flowing in the circuit. The strip of wood was fastened to the middle of BC, and was at right angles to the plane of $ABCD$ when in the position of equilibrium.

As will be seen from Maxwell's Art. 583 or my article in *World Power* of March 1932, the energy equation is either

$$F\,dy = \tfrac{1}{2}\,i\,dc \quad . \quad . \quad . \quad . \quad . \quad (1)$$

or

$$F\,dy = \tfrac{1}{2}\,i\,dk, \quad . \quad . \quad . \quad . \quad . \quad (2),$$

according to whether Faraday's law or Neumann's law is correct; and a measurement of F with any given value of i will show whether (1) or (2) is the correct equation. In each of the numerous cases that were tried, with various ratios of BM to BC and of BM to BA, the measured force was in close agreement with equation (2), though it was frequently (as in the case of Fig. 2) between 20 and 30 times as great as the force indicated by equation (1).

It may therefore be concluded, not merely that there is sometimes a great difference between the dc and dk that Maxwell thought to be identical, but also that Neumann's law is right and Faraday's is wrong.

W. F. DUNTON.

DURING recent years the points raised by Mr. Dunton in the above note have been discussed at considerable length in electrical journals. Indeed, controversy over the laws of electromagnetic induction has flared up periodically during the last half century. About forty years ago Carl Hering devised a number of ingenious experiments to show that 'flux cutting' was the essential factor in the generation of electromotive force. Some twenty years later, Blondel described in the *Electrician* an experiment in which the total flux linkage—as defined by the product of the flux and the number of turns—was reduced from a large value to zero without E.M.F. being induced in the circuit, his method being to unwrap a coil which had been wound upon a cylindrical magnet. A few years prior to this, I had carried out a number of experiments in an attempt to establish discrepancies between the 'flux cutting' and the 'rate of change of flux' theories, and in the correspondence consequent upon the publication of Blondel's work, I described one of the models I had made for that purpose.

This model is the one described above by Mr. Dunton; before it was built it was anticipated that no E.M.F. would be generated in its winding, and its behaviour on test fulfilled those expectations. However, I finally concluded that the action of the model was in line with that of the slotted armature generators now universally used, and the result of my investigations was to lead me to conclude that the total amount of 'flux cutting' is always equal to the change in the flux linkages. In short, my conclusions were in agreement with Art. 541 of Maxwell's classic book.

The behaviour of the model as a motor was never considered, but it follows that if its behaviour as a generator is in line with the slotted armature machine, such will also be the case for motor action. The action of motors with slotted armatures is well known, and it is also well known that the torque developed between stator and rotor is altogether greater than would correspond to the product of the current in the conductors and the flux density in the slot. In my opinion the model gave no evidence regarding the laws of electromagnetic induction and electrodynamics other than that long since available with slotted armature machines.

For the past few years, Mr. Dunton has, in a most energetic and far-reaching manner, challenged the validity of some of the commonly accepted laws. His work arises out of calculations connected with expanding circuits—such calculations being of particular importance in the design of circuit-breakers. One such example is given in Fig. 2 of Mr. Dunton's communication. Now the flux linked with a circuit may be changed in various ways, of which one (*a*) is by changing the current carried by the circuit, and another (*b*) is by maintaining the current constant and expanding the circuit as indicated, for example, by Mr. Dunton's Fig. 2. To my mind, there is no essential difference between these two cases. Nothing is to be gained by confusing the issue with mathematics, for the only real issue involved is the manner in which the magnetic field comes into being. If it be taken that the growth of the field in (*a*) is accompanied by a corresponding flux cutting it surely must follow that any new flux created in (*b*) also necessitates a corresponding flux cutting.

Quoting now from Mr. Dunton's letter: "The great difference between *dc* [that is, the flux cutting] and *dk* [that is, the change in the flux linkages], is accounted for by the fact that the stretching of *AB* and *DC* through the distance *dy* causes additional flux to be sent through the area *ABCD* by the added lengths *dy* at *M* and *N*". From this it is evident that Mr. Dunton has not concerned himself with how this additional flux comes into being, and if his interpretation of flux cutting be taken there is no flux cutting in case (*a*) above. It is my view, therefore, that Mr. Dunton's arrangements of expanding circuits give no evidence—in support or otherwise of the validity of Art. 541 of Maxwell's "Treatise on Electricity and Magnetism"—other than that presented by the case of simple circuits carrying changing currents.

The issue involved is, of course, one of pure physics. With the great developments that are taking place in atomic physics one can look forward to the time when physicists will wrest further secrets from Nature and give to electrical engineers a clearer conception of what is really happening in magnetic fields, and of the 'mechanism' by which E.M.F. is actually induced in a circuit. But at the moment I see no reason for abandoning existing conceptions.

A. E. CLAYTON.

The Carnegie Institution of Washington

THE report of the president of the Carnegie Institution of Washington for the year ending October 31, 1936, reviews the relationship of its existing policies to research, and examines some of their implications as well as giving a brief account of researches in progress (Washington, D.C.: Carnegie Institution, 1937). The Institution has so far limited itself largely to securing new data and to the organization of information relating to mathematical research, investigation of natural phenomena and to history. The value of science in terms of its contribution to meet human needs is shown in many ways, but the Institution has also been concerned with the ways in which science can be effectively utilized to deal with difficult human relations such as those represented by economics and government. These possibilities have been recognized with the assumption that the best method of procedure is by co-operation between the sociologist, economist, or student of government and representatives of sciences with closely allied methods or problems.

The Institution has endeavoured to secure the practical application of results of research, whether from the physical or biological sciences or in human values, as in psychology, and the importance of bringing together, in appropriate organizations, scientific workers and engineers and students of social and economic problems, with a view to the utilization of new ideas and techniques, is stressed. Responsibility in this field rests in part upon the scientific worker, and it is essential that the possible influence of science upon thought, and in the development of techniques which influence modes of thought, should receive close attention. Even in international relations the cultural and economic significance of science should not be overlooked.

In the field of astronomical research the work of the Mount Wilson Observatory has reached a stage when the accumulation of data permits the formation of new patterns with new theories and new points of view. The appearance of a bright nova in the constellation of Lacerta on June 18, like that of Nova Herculis, has received careful study, while a supernova has been discovered in one of the extra-galactic nebulæ of the Virgo cluster. An extensive preliminary survey has been made of the number and distribution of the extra-galactic nebulæ corresponding to the Milky Way, and measurements of the red shift of remote nebulæ have received intensive study. The Department of Terrestrial Magnetism, in addition to studies on the causes of fluctuations in the earth's field, has investigated the question of magnetic disturbances, including world-wide magnetic storms, as well as the relation of magnetism to atomic physics, in which field it has been shown that protons and neutrons are probably identical in every respect except that of electrical charge. The Geophysical Laboratory has investigated the equilibrium between crystalline minerals, usually silicates, and their melts, including the equilibria of rock-forming silicates at atmospheric pressure, and has been responsible for a series of determinations of the radium content of samples obtained from the ocean-bottom.

Important seismological research has been carried out at Pasadena, and the Division of Plant Biology has been responsible for intensive studies of individual functions and components of plants as well as in photosynthesis, including the carotenoid pigments and the absorption of carbon dioxide by the unilluminated leaf. The work of the Division of Animal Biology has been characterized by increasing co-operation with other groups. Definite evidence has been obtained concerning factors involved in the origin of tumours. Much light has been thrown upon the development of the layers which are defined in early stages of the embryo, and studies in endocrinology have been concerned with the influence of prolactin, and the milk-producing hormone.

Other important studies have been concerned with genetics and nutrition, while the Division of Historical Research has concentrated attack on the early history of the Maya and major questions relating to the advance of civilization which have emphasized the value of data from other civilizations for testing modes of life and growth of an advancing civilization.

Fourth International Grassland Congress

THE paper-reading sessions of the fourth International Grassland Congress were held at Aberystwyth on July 14–18, under the presidency of Prof. R. G. Stapledon. A preliminary tour was arranged from Oxford through Leicestershire, the Cotswolds, Herefordshire and central Wales; a party of two hundred delegates left Oxford on July 10 and arrived in Aberystwyth on July 14. Delegates who participated in this tour had excellent opportunities of studying the modern developments in English grassland farming, such as the use and production of pedigree seed, artificial drying of grass, etc., and were therefore in a better position to appreciate the papers read afterwards by British specialists at the Aberystwyth meeting.

The numerous papers offered for presentation to the Congress were divided among plenary and sectional sessions. The plenary papers were divided into three groups, dealing with nutritional questions, herbage plant breeding and general grassland research respectively. The sectional sessions, held on July 16, covered the six subdivisions of grassland research, namely, (1) grassland ecology, (2) seed mixtures, (3) plant breeding and seed production, (4) manures and fertilizers, (5) nutritive value of pastures and fodder conservation, and (6) management, yields and economics of pastures.

The subject-matter of the papers read is perhaps best dealt with according to country; this Congress differed in scope from its three predecessors, held in Germany, Scandinavia and Switzerland respectively, as the 450 delegates came from thirty-seven countries in all parts of the world, and were therefore interested in more varied aspects of the grassland problem than at the earlier conferences.

The British papers were concerned chiefly with the breeding of pure-bred grasses and clovers (T. J. Jenkin and R. D. Williams, Aberystwyth), the production and marketing of seed of pure-bred strains (T. E. Miln, Warrington, and Gwilym Evans, Aberystwyth), the use of lime and phosphate in grassland improvement (J. A. Hanley, Newcastle, and R. G. Heddle and W. G. Ogg, Edinburgh and Aberdeen), the production and nutritive value of artificially dried grass (H. E. Woodman, Cambridge, and E. J. Roberts) and the economics of grassland improvement (John Orr, Manchester).

An important European paper was that delivered by A. I. Virtanen, Finland, on the associated growth of legumes and non-legumes; the old-established fact that non-legumes benefit by an association with legumes has been explained by recent work in his laboratory at Helsinki. Exact work with sterile culture technique has conclusively shown that nitrogenous compounds are excreted into the soil from legume nodules, and that this excretion commences immediately upon the formation of nodules. The excreted nitrogen compounds are products of nitrogen fixation and not decomposition products of proteins; the excretion products have been studied in an attempt to shed light on the mechanism of nitrogen fixation. The excretion is apparently an equilibrium reaction. Excretion of amino-acids has been demonstrated with all legumes so far examined (different species of clover, peas and lucerne). Application of nitrate appears to lower markedly the excretion.

A wide range of topics was covered by readers from other European countries. The Scandinavian countries have always been in the forefront as regards breeding of herbage plants; they were here represented by N. Sylvén and H. Osvald, Sweden, and O. Valle, Finland. C. K. van Daalen, Holland, also stressed the importance of using indigenous or pure-bred seed when sowing down pastures.

Papers on the grasslands of Hungary, read by K. T. Kolbai and J. von Piukovich, indicated the rapidly increasing interest in the subject in that country, where there are now three grassland unions with 60,000 farmer members. Another paper from the same country, by N. von Bittera, dealt with the peculiar problems of applying fertilizers to arid grassland, a subject of direct importance to the delegates from North America, Africa and Australia.

The profitability of applying nitrogenous fertilizers was discussed by readers from Sweden, Holland and Germany, the conservation of grassland herbage in the form of silage by delegates from Great Britain, Switzerland and Germany, and the good effect of alpine pasturing upon the health of stock by V. Vezzani and E. Carbone of Italy. One of the leading grassland experts from Germany, E. Klapp of Bonn, compared the effects of mowing and grazing upon pastures in general and upon certain herbage grasses and legumes in particular.

The outstanding value of pastures in erosion control has been an important factor in the rapid growth of pasture research in the United States and Canada in recent years. It was therefore not surprising that these two countries should be well represented at the Congress; the American delegation, under its chairman, P. V. Cardon, principal agronomist in charge, Division of Forage Crops and Diseases, Bureau of Plant Industry, U.S. Department of Agriculture, numbered fifty persons, the majority of whom were travelling in one party under the guidance of Dr. D. B. Johnstone-Wallace, Cornell University, on a tour of centres of grassland and scenic interest in Great Britain, Scandinavia, Germany, Austria, Switzerland and France.

Papers representing the current American outlook were read by three members of the U.S. Department of Agriculture, namely, P. V. Cardon (Bureau of Plant Industry), W. R. Chapline (U.S. Forest Service), and C. R. Enlow (Soil Conservation Service), who dealt respectively with the new herbage plant breeding programme, the revegetation and rehabilitation of the range lands of the western States and the value of pastures in erosion control. D. B. Johnstone-Wallace described his experiments with wild white clover at Cornell University in New York State, which have been attracting so much attention in recent years among the pasture agronomists working in the more humid parts of the eastern United States.

L. E. Kirk discussed the herbage plant breeding problems of eastern and western Canada, while O. McConkey directed attention to the serious mineral deficiencies in the pastures of eastern Canada.

H. R. Marston presented in scientific terms the Australian sheep farmers' argument that "sown pastures ruin the wool" of the merino sheep. Improvement of the nutritional level of a pasture from one which has seriously handicapped production will certainly affect the quality (fineness) of the fleece, but this change may just as certainly be made, if need be, by the alteration of the type of sheep used for wool-growing on these areas. Small-framed, densely covered breeds of merinos which have been selected to produce fine wool when grazed on richer areas are well known.

E. Bruce Levy described the conversion of rain forest to grassland in New Zealand; the forests converted are mainly of two types: rain forest proper and sub-antarctic southern beech forest. The stages of the conversion to the famous pastures of New Zealand were described in full, particular credit being given to the pioneer back-country bush settlers. A similar topic was discussed by G. H. Holford, New Zealand, who illustrated his talk with a colour film.

The changing agricultural outlook in South Africa, resulting from the ravages of soil erosion, was described by the representative of the South African Department of Agriculture, J. W. Rowland. A reorientation of the principles of arid land farming must come about, governed by a full consideration of the land, in the light of the complex inter-relationship between the soil, the plant and the climate.

The Congress ended with a tour through Northumberland to Edinburgh, when a day was spent in the Central Highlands of Scotland and the Trossachs.

The report of the Fourth Congress, containing the full text of all papers read, together with their English and German abstracts, will be published in October or November of this year, price £2 per copy. A volume containing the abstracts only (in English and German) is now available, price 5*s*., and may be obtained from the joint Secretaries, Fourth International Grassland Congress, Aberystwyth.

At the general meeting of the International Grassland Congress Association on July 16, Dr. D. S. Huizinga of the Netherlands repeated the invitation, already given at the Third Congress at Zürich, to hold the Fifth Congress in the Netherlands in 1940. The invitation was gratefully accepted, and Dr. Huizinga was elected president of the Fifth Congress The Association was invited by Count Teleki of Hungary to hold its sixth meeting in that country in 1943.

Geology of Jersey

THE claims of Jersey in the Channel Islands as a field of research for British geologists and as a most suitable locality for field classes for students has more than once been urged. The chief reason why Jersey is not more widely used for the latter purpose, in spite of its undoubted attractions, is the lack of a modern complete connected account of the geology of the island.

In September 1934, the Geological and Mineralogical Society of Brittany visited the island under the direction of A. J. Robinson and A. E. Mourant. The report of the excursion has recently been published as a memoir of the Society[1], and should prove invaluable to geologists intending to visit Jersey. The work is in French; but it is typical scientific French, and the writers clearly realized that many of its readers would be English-speaking. Probably for this reason, the work of those English geologists who established the succession and relationships of the rock groups of Jersey is barely mentioned. In justice to them, however, it should be stated that the relationships described by Wells and Wooldridge[2] are accepted by the writers of the memoir, with one exception; they claim that no important break occurs between the St. Lo shales and the volcanic group.

A broad outline of the geology of Jersey is condensed into the first few pages, while the rest of the first part of the memoir is taken up by a detailed day-by-day account of the excursion. The memoir is, however, much more than a mere itinerary: it includes discussions of the many problems of age and field relations which still await complete solution. Thus the commonly accepted view that the lavas are of Pre-Cambrian age and probably to be correlated with the Uriconian volcanic rocks of Britain, is re-examined in the light of a careful comparison between the Jersey lavas and those of the mainland of Brittany, and in view of the claim strongly urged by M. Y. Milon, of the University of Rennes, that the lavas of Paimpol are of Carboniferous, not Pre-Cambrian, age.

M. Milon himself contributes interesting "Notes and Observations on the Geology of Jersey and Armorica". In particular, the age and conditions of accumulation of the Rozel conglomerate group are discussed, and it is concluded that these rocks, so strikingly similar to the Permian breccio-conglomerates of eastern Devonshire, were deposited on the borders of a Permo-Triassic cuvette, under 'continental' conditions.

In addition to the solid geology, the Pleistocene deposits, the raised beaches and the caves are adequately described by M. A. Bigot in the second part of the memoir.

Although natural inland outcrops are few in Jersey, the island provides a magnificent series of coastal exposures in the cliffs and extensive wave-cut platforms. In the main, these exposures are not difficult of access; but the casual visitor is liable to disappointment unless the tides are studied and the routes so chosen as to take full advantage of the periods of low water. With commendable foresight, the authors recommend in the introduction that the conditions are most favourable during the period comprising the three days before new or full moon and the five days which follow. The authors are resident in Jersey, and their detailed local knowledge has ensured that in the course of the five journeys described the time would be used to the best advantage and the maximum of geology would be seen. Each route is clearly shown on a sketch-map, with localities numbered to correspond with the text. For those with more time at their disposal, additional excursions are suggested.

Among the nineteen figures included in the text are several geological sketch-maps on a generous scale, while a folding geological map on the scale of 1 : 50,000 and five plates are incorporated.

A. K. W.

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[1] "Contributions à l'étude géologique des Iles de la Manche et du Trégorrois." *Mem. Soc. Géol. et Min. de Bretagne*, 3 (1936). Obtainable from Prof. Y. Milon, Institut de Géologie, Rennes (30 francs), and the Museum, 9 Pier Road, Jersey (5*s*.).

[2] *Proc. Geol. Assoc.*, [illegible], 78 (1931).

Science News a Century Ago

The Entomological Society

At a meeting of the Entomological Society held on August 7, 1837, Mr. Bowerbank exhibited specimens of cork infused by termites while on board ship, and suggested measures to prevent attack by such insects; Mr. Bainbridge spoke of the damage to apple trees in the neighbourhood of Lambeth by a small species of moth; and Mr. Westwood gave an account of an entomological visit he had lately made to Paris, noticing among other things a disease called muscadine with which silkworms had been very extensively attacked in France. The malady was a parasite which gradually enveloped the whole body in a white fungus and destroyed the worm, the mischief being produced by the explosion of a fungus, which is taken in by the spiracles or pores of the skin, as has been proved by M. Audouin, who has inoculated several worms and beetles with it. In concluding, Mr. Westwood made some remarks on the progress of entomology in France, which he stated to be in advance of Great Britain, there being more working cultivators, and the collection at the Jardin des Plantes being superior to that at the British Museum; M. Audouin had just completed a course of fifty lectures on entomology.

Bradley's Zenith Sector sent to the Cape

When Maclear became Astronomer Royal at the Cape of Good Hope in 1833, one of his first tasks was to re-measure and extend the arc of meridian measured by the French astronomer Lacaille in 1752. To further this work, Airy, on February 24, 1837, wrote to Captain Beaufort, the hydrographer at the Admiralty, suggesting that Bradley's sector then at Greenwich should be used for verifying the astronomical determinations. The Admiralty agreed to the suggestion, the sector was re-mounted, careful drawings were made of every part, instructions were prepared for its use, and on August 10 it was sent to Woolwich Dockyard and shipped for the Cape. Maclear commenced his verifications of Lacaille's arc in 1838, between 1840 and 1847 the field work was accomplished, and the sector was returned to Greenwich in 1850.

The sector was originally made by George Graham for Bradley in 1727. It had a radius of 12½ ft. and a range of 12½°. It was mounted by Bradley at his aunt's house at Wanstead, and it was from observations made with it that he was led to the discovery of aberration and mutation. In 1742, Bradley succeeded Halley as Astronomer Royal, and in 1749 the sector was removed to Greenwich. It is now preserved with other historic instruments at the Royal Observatory.

Sir Thomas Maclear, who was born in 1794 and died in 1879, was director of the Cape Observatory until 1870. He was knighted in 1860, and for his geodetical work received the Lalande Medal of the Paris Academy of Sciences and a Royal Medal of the Royal Society. He is buried in the grounds of the Observatory.

Magneto-Electric Currents

"M. Auguste de la Rive has been studying the properties of magneto-electric currents, and among other results he finds that the helix of a metallic thermometer heats to 7° when there are but two currents alternating contrary every second; to 55° with nine currents; to 100° with twenty currents; and to 133° with forty currents; and that a fine wire of platina has been heated red-hot when the succession of currents have been even more rapid. Chemical effects are subject to the same influence, only that there is a limit at which the heat of decomposition slackens. The influence of this speed is also felt in physiological processes, which acquire much greater energy than when produced by voltaic currents; a phenomenon which may be attributed to the interruption and alternatively contrary direction of magneto-electric currents, and which, perhaps, may become advantageous in the practice of the medical art" (*Athenæum*, Aug. 12, 1837).

Typhoid and Typhus Fevers

The issue of the *American Journal of Medical Sciences* of August 1837 contains the first clear distinction between typhoid (dothinenteritis) and typhus fevers. The writer was Dr. W. W. Gerhard, physician to the Philadelphia Hospital, Blockley, and his paper was entitled "On the Typhus Fever which occurred at Philadelphia in the Spring and Summer of 1836". The principal differences between the two diseases are summed up as follows: "Dothinenteritis is usually a sporadic disease, although it sometimes appears to be a widespread epidemic. In the latter case the symptoms are so well marked that these are never doubtful except in a few of the earliest examples. Now typhus is rarely sporadic, and if scattering cases do occur, they are generally connected with an epidemic and follow it. . . . (2) Typhus is evidently very contagious; in the epidemic of 1836 it is quite as contagious as small-pox. . . . Dothinenteritis is certainly not contagious under ordinary circumstances, although in some epidemics we have striking reason to believe that it becomes so. (3) The initial symptoms of the two affections chiefly differ in the greater stupor, dullness and prostration of typhus, which are in strong contrast to the moderate cephalalgia and disturbance of the senses in dothinenteritis. . . . When the disease is completely formed, the characters on which the distinction between the two forms of fever rest are: (1) The suffusion of the eyes, which occurs in every case, or nearly every case of typhus fever, with the dusky red aspect of the countenance. (2) The extreme stupor and inactivity of the mind, even when positive delirium does not exist. (3) We also observe in typhus no constant abdominal symptoms, and at first merely dullness on percussion and feebleness of respiration at the posterior surface of the lungs. If to these symptoms be added the peculiar eruption of petechiæ which is scarcely ever absent in whites, there remains hardly a possibility of error."

A Female Rhinoceros in the Zoo

The August issue (No. 59) 1837 of *Neue Notizen aus dem Gebiete der Natur- und Heilkunde* contains the following announcement: "A female rhinoceros in the garden of the Zoological Society of London is the latest and most interesting acquisition which this menagerie has made. It is a very fine young animal, but only half the size of the male rhinoceros which has been in the possession of the Society for several years. This is the first time, so far as we know, that a rhinoceros pair (male and female) has been exhibited at the same time in Europe."

Societies and Academies

Dublin

Royal Irish Academy, May 31

J. J. HARTLEY: The Dalradian rocks of the Sperrin Mountains. The paper dealt with the Dalradian sequence as developed on the borders of Counties Derry and Tyrone in Northern Ireland. The stratigraphical succession was described, and a detailed correlation suggested with Kintyre and Corval in south-west Scotland. Attention was directed to the influence the important faults which traverse the area have upon the structure and the light which they throw on the character of the folding. The question of the metamorphism was briefly discussed.

J. KAYE CHARLESWORTH: A map of the glacier lakes and local glaciers of the Wicklow Hills. This portrays the distribution of the local glaciers (in the main after A. Farrington) and of nine chains of glacier lakes impounded by the extraneous ice on either side of the Wicklow Hills.

K. G. EMELÉUS, E. B. CATHCART and C. M. MINNIS: Some electrical and optical properties of iodine vapour. The intensity distribution and absolute intensity in the iodine atom electron affinity spectrum have been calculated for typical discharge conditions from the results of probe analysis and theoretical capture cross-sections. The main part of the spectrum is usually in the far ultra-violet. The intensity in the near ultra-violet is so small as probably to preclude its observation. A high-frequency discharge with a constricted positive column is described which is of interest in connexion with the mechanism of the positive column. The effect of formation of negative ions in hindering removal of impurities by the discharge is pointed out.

Paris

Academy of Sciences, June 7 (*C.R.*, 204, 1693–1768).

HYACINTHE VINCENT: The antitoxic power of glutathione on the diphtheritic and tetanic toxins. Glutathione shows a slight but distinct antitoxic power towards the toxin of diphtheria.

ANDRÉ BLONDEL: The experimental study of coloured signals intended for navigation.

WOLFGANG DŒBLIN and ROBERT FORTET: On two notes of Kryloff and Bogoliouboff.

W. STEBODZINSKI: A class of surfaces of affine space.

HENRI DULAC: Research on limit cycles.

DRAGOSLAV S. MITRINOVITCH: A differential equation of the first order occurring in various problems of geometry.

ANDRÉ MACHIELS: Concerning a criterion of the reality of the velocities of nebulæ. Criticism of the method of E. Hubble based on spectroscopic and photometric data.

GÉRARD PETIAU: The matrix representation of the Maxwell equations.

GEORGES ALBERT BOUTRY and GEORGES TRÉHERNE: Commutable and stable electrical contacts. The variation in the resistance of sliding or plug contacts is too large for use in high-precision electrical thermometry. A new form of contact is described (mercury-platinum in a vacuum) giving resistances constant to within two microhms.

OLEG YADOFF: The electrical and mechanical ageing of copper conductors under the prolonged action of the electric current. Prolonged passage of current (two years) through copper conductors produces a loss in mechanical strength and a slight increase in the electrical conductivity.

ROBERT FORRER: The intensity of orbital interaction in compounds with multiple ionization.

GABRIËL BOSSCHIETER and JACQUES ERRERA: The infra-red absorption spectra of water, liquid, solid and in solution. Comparison of the infra-red spectra of water in the liquid and in ice with solutions in carbon tetrachloride and carbon bisulphide.

MLLE. DINAH BIQUARD: The Raman spectra of some ketones. The influence of ring formation.

STANISLAW ROUPPERT: The action of the magnetic field on the absorption of selenium.

AUGUSTE ROUSSET: New measurements of the factor of depolarization of light diffused by argon. Improvements in the construction of the apparatus lead to a factor of depolarization for argon equal to 3×10^{-4} with incident parallel polarized light. The factor is certainly below 10^{-3}.

SALOMON ROSENBLUM and MARCEL GUILLOT: The γ spectrum of RaB and RdAc.

PIERRE BARCHEWITZ and RENÉ FREYMANN: The complexity of the (OH) infra-red absorption bands.

JOSEPH LAISSUS: The cementation of nickel by beryllium. The Brinell hardness of nickel cemented by beryllium is one of the highest determined on metallurgical products.

MARCEL PRETTRE: The heterogeneous combustion of mixtures of carbon monoxide, hydrogen and oxygen on a vitreous surface. The heterogeneous combustion of most mixtures of hydrogen, carbon monoxide and oxygen is controlled by the velocity of oxidation of the hydrogen.

ANDRÉ CHRÉTIEN and JEAN KRAFT: The uranyl phosphites. The sole product of the interaction of solutions of phosphorous acid and uranyl acetate is a neutral uranyl phosphite, $UO_2HPO_3 2H_2O$.

MLLE. SUZANNE HÉMAR: The precipitation in the cold of a copper salt by an alkaline carbonate.

HENRI GUÉRIN: The magnesium arsenates.

H. CLÉMENT and J. SAVARD: The halide of pentamethylmagnesium.

LOUIS LONGCHAMBON: The dehydration of coals.

HELGE G. BACKLUND: Some eruptive rocks of the basalt series from the eastern coast of Greenland.

HENRI HUMBERT: *Gentianothamnus*, a new genus of Gentianaceæ from Madagascar.

ROBERT WEILL: The existence of a monocnidome in the medusoid of a polypus (*Pennaria*(?) *tiarella*) with tetracnidome.

ERNEST KAHANE and MLLE. JEANNE LÉVY: The mechanism of the sensitization with acetylcholine.

MLLE. ETIENNETTE BIZET and RAYMOND-HAMET: The opposed effects of two alkaloids from the same vegetable drug.

EMILE F. TERROINE, MLLES. A. M. DE LA BERNARDIE and PAULE LELU: Action of the external temperature on the metabolism of creatinine and creatine.

ANDRÉ BOIVIN and MME. LYDIA MESROBEANU: The existence of a thermo-labile toxin and neurotrope (exotoxine) in the bacterial bodies of the Shiga bacillus.

LÉON BINET, CHARLES JAULMES and GEORGES WELLER: The antitoxic power of glutathione. Researches on the tetanus toxin.

ERNEST FOURNEAU, JACQUES TRÉFOUËL, FEDERICO NITTI, DANIEL BOVET and MME. JACQUES TRÉFOUËL: The anti-streptococcic action of organic sulphur derivatives.

Moscow

Academy of Sciences, *C.R.*, 15, No. 1; 1937.

N. S. Košliakov: A transformation of definite integrals and its application to the theory of Riemann's function $\zeta(s)$.

E. Liustich: Some methods for mechanical integrators.

V. G. Čelidze: The derived numbers of a function of two variables.

V. Niemytzki: (1) The integral non-linear equations comparable to the linear equations. (2) The most generalized integral non-linear equation.

N. Piskunov: The limit problem for an equation with partial derivates of hyperbo-parabolic type.

E. J. Perepelkin: An apparatus for quick and accurate reduction of self-registering micro-photometer records.

A. A. Šišlovskiy: A comparison of absorption and fluorescence spectra of anthracene in different states of aggregation.

F. A. Korolev: The application of Toeppler's method to measuring the absorption of ultra-sounds in liquids.

K. G. Mizuč: Side processes of oxidation during the reduction of nitrogen compounds of the aromatic ries (2). Action of a bivalent iron salt on arylhydroxylamines.

I. B. Plešakov: The stratigraphy of the Tertiary oil-bearing beds of the south-eastern part of the Soviet Sakhalin.

A. G. Eberzin: The Pontic rocks of Mingrelia.

I. A. Smorodincev, N. N. Krylova and V. I. Pasonina: Changes of protein fractions in meat ripening.

V. A. Novilov: Derangement of metabolism in the leaves of lucerne when infected with the rust *Uromyces striatus* Schröt.

N. Dragomirov: (1) Experimental induction of retina in amphibian embryos. (2) Influence of the adjoining ectoderm on the organization of the eye bud.

Vienna

Academy of Sciences, May 13.

Berta Karlik and Karl Przibram: Infra-red luminescence spectrum of samarium. The spectrum found by Tomaschek is ascribed to divalent samarium.

Marietta Blau and Hertha Wambacher: Measurement of the length of proton tracks by the photographic method. A few tracks have been recorded of protons liberated by neutrons from a polonium-beryllium source and of a length corresponding to an energy of between 7·9 and 10 million electron volts. The percentage of these high-energy neutrons is determined.

Margarethe Holuba: Influence of absorption in the interior of a radioactive preparation on the emitted radiation.

K. W. F. Kohlrausch and R. Skrabal: Studies of the Raman effect (71). Cyclopropane carboxylic acid, acrylic acid and their derivatives.

A. W. Reitz and R. Skrabal: Studies of the Raman effect (72). Nitrogenous bodies (4). Nitriles.

S. Feitelberg and H. Lampl: Determination of the point of attack of drugs affecting the brain by measurement of the heat developed in different parts of the brain.

Klaus Unna and Leopold Walterskirchen: Influence of pituitrin on the action of some diuretics.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Junior Scientific Officers in the Electricity, Radio and Aerodynamics Departments of the National Physical Laboratory, Teddington—The Director (August 9).

Lecturer in Mechanical Engineering in the Batley Technical College—The Director of Education, Education Offices, Batley (August 14).

Assistant (grade II—engineering) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch) (August 16).

Two Demonstrators in Inorganic Chemistry in the University of Leeds—The Registrar (August 23).

Junior Lecturer in Mycology in the Imperial College of Tropical Agriculture, Trinidad—The Secretary, 14 Trinity Square, London, E.C.3 (August 31).

Assistant Lecturer in Mathematics in the University of Manchester—The Registrar (September 1).

Astronomer Royal for Scotland and Professor of Astronomy in the University of Edinburgh—The Private Secretary, Scottish Office, Whitehall, S.W.1 (September 13).

University Professor of Pharmacology in the College of the Pharmaceutical Society of Great Britain—The Academic Registrar, University of London, W.C.1 (September 14).

University Reader in Bacteriology in the British Postgraduate Medical School—The Academic Registrar, University of London, W.C.1 (September 15).

Assistant Lecturer in Electrical Engineering in the Manchester Municipal College of Technology—The Registrar (September 20).

Metallurgist, Engineer or Chemist for the Mond Nickel Co.—The Manager, Research and Development Dept., The Mond Nickel Co., Ltd., Thames House, Millbank, S.W.1.

Technical Assistant in the Information Department of the Automobile Research Laboratories—I.A.E., Research Department, Great West Road, Brentford, Middlesex.

Official Publications Received

Great Britain and Ireland

National Trust for Places of Historic Interest or Natural Beauty. Freehold and Leasehold Properties of the Trust and Protected Properties. Pp. xv+88+26+8 plates. Report, 1936–1937. Pp. x+140. (London: National Trust.) [87

Institute of British Geographers. Publications Nos. 4 and 5: (4) Transactions and (5) Insolation and Relief: *their Bearing on the Human Geography of Alpine Regions.* By Alice Garnett. Pp. xvi+71. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd.) 12*s.* 6*d.* [87

Report of the Import Duties Advisory Committee on the Present Position and Future Development of the Iron and Steel Industry. (Cmd. 5507.) Pp. 117. (London: H.M. Stationery Office.) 2*s.* net. [97

Other Countries

Transactions of the San Diego Society of Natural History. Vol. 8, No. 23: *A Further Report on Birds from Sonora, Mexico, with Descriptions of Two New Races.* By A. J. van Rossem and the Marquess Hachisuka. Pp. 321–336. Vol. 8, No. 24: Paleontology of the Pleistocene of Point Loma, San Diego County, California. By Robert W. Webb. Pp. 337–348. Vol. 8, No. 25: Descriptions of New Mammals from Arizona and Sonora, Mexico. By Laurence M. Huey. Pp. 349–360+plate 23. Vol. 8, No. 26: A Northwestern Race of the Mexican Black Hawk. By A. J. van Rossem and the Marquess Hachisuka. Pp. 361–362. (San Diego, Calif.: San Diego Society of Natural History.) [57

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 89. Zoological Results of the George Vanderbilt African Expedition of 1934. Part 7: Reptiles and Amphibians. By Arthur Loveridge. Pp. 265–296. (Philadelphia: Academy of Natural Sciences.) [57

Imperial College of Tropical Agriculture. Sixth Annual Report on Cacao Research, 1936. Pp. 51. (Trinidad: Government Printing Office.) 5*s.* [57

National Research Council of Canada. Heat Loss through Windows: a Summary of Available Information. By R. Ruedy. Pp. 38. (Ottawa: National Research Council.) [67

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1936. Pp. 18. (Pretoria: Government Printer.) [67

Union of South Africa: Department of Mines. Bulletin No. 8: "Wonderstone". By Dr. Louis T. Nel, Dr. H. Jacobs, J. T. Allan and G. R. Bozzoli. Pp. 44+6 plates. 6*d.* Bulletin No. 9: The Ochre Deposits of the Riversdale District, Cape Province. By D. J. L. Visser. Pp. 21. 3*d.* Memoir No. 31: The Pegmatite Area south of the Orange River in Namaqualand. By Dr. T. W. Gevers, F. C. Partridge and G. K. Joubert. Pp. 180+16 plates. 7*s.* 6*d.*, including Map. (Pretoria: Government Printer.) [67

Baltische Geodätische Kommission. Sonderveröffentlichung No. 6: Relative Bestimmungen der Schwerkraft auf den Landeszentralen. Ausgeführt von der Baltischen Geodätischen Kommission in den Jahren 1930 und 1935. Pp. iii+128. (Helsinki: Baltische Geodätische Kommission.) [87

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Science in Social Services

IN his farewell address on June 24 to the London School of Economics, Sir William Beveridge emphasized the need for both observation and detachment in the social sciences. Failure to be scientific in method and detachment on the part of both economists and statesmen, he said, had largely been responsible for the tardy development or recognition of the social sciences, alike in the neglect of observation of facts as the basis of theories and as the control of theories, and in the lack of detachment from partisan actions and the giving of judgment on controversial political issues. The social services of Great Britain might well have been cited by Sir William Beveridge to illustrate his point. They continue to grow piecemeal, and every session Parliament adds something to the imposing structure; but it is nearly thirty years since the last comprehensive inquiry into public social provision in Great Britain was made. Continually, however, we witness particular aspects of the social services criticized strongly to prove or disprove some political tenet or preconceived idea, and it is rare indeed to find them considered in relation to a comprehensive and well-defined social policy.

The report on the social services which has just been issued by P E P (Political and Economic Planning) accordingly meets a definite need as well as provides a noteworthy example of the type of impartial and comprehensive analysis of the facts desiderated by Sir William Beveridge. The report has the freedom from preconceptions which characterizes the investigations of P E P and gives us a comprehensive and detailed examination of each of the social services.

With some of these individual social services, which are grouped in three categories—namely, constructive community services, such as education and public health and the employment exchanges; social insurance services, such as national health insurance, unemployment insurance, widows', orphans' and old-age contributory pensions, as well as workmen's compensation; and social assistance services, such as non-contributory old-age pensions, unemployment and public assistance—scientific workers may have their own particular contact as individual citizens. With the collective review of the services as a system, the mapping of the ground they cover, and the intervening gaps, as well as with the indications which this report affords of trends in policy which are not yet fully developed in the existing social services, scientific workers will, however, have a keen, if not a professional, interest.

The admirable survey and analysis which are provided in this report are primarily a stimulus to further constructive thinking; and opinions in some matters that have sometimes ranked as established convictions will require re-examination by unprejudiced students. Despite the great increase in the last thirty years of expenditure on social services, which now reaches the sum of £400,000,000 a year, that is, nearly £9 a head, or about a tenth of the national income of 1934, 71 per cent of which is financed out of rates and taxes, the report shows clearly that there has been no spectacular transfer of wealth from rich to poor. Indirect taxation of the working classes has increased side-by-side with the direct taxation of the well-to-do.

The main argument of the report is not that we should begin to economize on our social services but that we should plan them better. At present they are the result of piecemeal political and administrative improvisations which need replacing by a more deliberate social service policy, a continued review with a programme of priorities and the filling of gaps. Many of these gaps, as well as serious anomalies and defects, wide disparities, and abuses, appearing unchecked in our present system, are duly pointed out in the report, which leaves no doubt of the room for reform. But the report does more than this. It assists the emergence of a mature philosophy and a broad strategy of the social services, and thus the replacement of fairly strong but largely unconscious tendency by conscious purpose.

This establishment of guiding principles, and of authority to ensure their observance in practice, is best secured not by a Royal Commission, which is regarded as too cumbersome, but by the establishment of a Social Service Statutory Committee, acting as an advisory general headquarters staff. The value of this type of detached examination and criticism is demonstrated by the experience of the Unemployment Insurance Statutory Committee and of the Law Revision Committee. The suggested committee would have three main duties: to study the basic principles of the services; to promote efficient and economic working, indicating any needful change of administrative and financial structure; and to direct attention to anomalies and gaps, making remedial proposals.

Scientific workers will be quick to recognize in this suggestion something of the ideas expounded by General Smuts in his Sidgwick Memorial Lecture on "Democracy"; and this further plea for an extension of scientific method and inquiry into controversial matters which should be settled on a basis of fact, and not prejudice, will be welcomed by them. Equally, too, the report makes clear the impossibility of isolating politically the social services. Economic policy, social service policy, and industrial wage policy are closely interlocked. Under our present health insurance system bad industrial organization may be persistently subsidized. The powers provided under the National Health Insurance Act to survey the health of local communities, and penalize employers responsible for high sickness rates, have never been used, and certain factories and offices continue to be so unsatisfactorily arranged or operated that they give rise to excessive numbers of sickness claims.

The increasing part which scientific workers take in the administrative side of industry gives them special responsibilities in these matters, and the report also comments on the failure of those in charge of the great public social insurances of the United Kingdom to be alive to these questions and to take the broad view of their functions in helping to reduce accidents and disease, which some private enterprise insurance companies have done. Dereliction of duty of this type is one of the prime concerns of associations of professional workers, and it is clear that such associations need much more general support from the rank and file of the professions and also continued stimulus if their functions are to be fully and wisely discharged.

The clear thinking of this report, no less than its analysis of the facts, can scarcely fail to be highly suggestive to many scientific and professional workers and to stimulate further thought and effort in many fields. There are, however, other matters of immediate personal concern to scientific workers on which the report touches. For example, in its summing-up of the problem of the family, the report favours the introduction into the general wage and salary system of Great Britain of the principle of family allowances, to which social reformers as well as industrialists have been largely opposed. The report argues that public social services must either consciously be used as an agency for adjusting burdens as between large and small families, or else they will tend more and more to reinforce those commercial and other agencies which are steadily making it less attractive for the average citizen to rear a family.

A second matter raised by the report, which is also of direct concern to scientific workers, is that of the personnel of social service administration. On this subject it makes two main criticisms. The preparation of the report has revealed a serious amount of compartmental outlook and experience as characterizing those engaged in the administration of the social services at this stage. There are many men and women who are well informed about particular branches or aspects, but it is rare to find anyone who has given much thought to the inter-relations of the social services with one another, or to their repercussions on social or economic life and to their lines of development.

One of the first needs of to-day is the breakdown of this sectionalism and departmentalism; those concerned with particular aspects or subjects should start thinking intensively about the place of their own specialism in the whole scheme of the social services. In part, this is a matter in which professional associations could exert a useful influence, and their direct contribution to the effective co-ordination of the social services with one another, and with national policy as a whole, or to the re-examination of the forms of democratic control and public accountability in the social services, should not be negligible. In part, however, it is a matter of recruitment, and here the report refers to the failure to implement the recommendations of the Departmental Committee on the Recruitment and Training of Local Government Officers, in its report issued in 1935.

The need for improved recruitment and training is not, however, confined to the local government service. Although the quality of the personnel is often of the highest order, existing arrangements for the recruitment and training of officers for certain forms of social work, for example, the work of the Unemployment Assistance Board, are not entirely satisfactory. Apart from the importance of recruiting officers for the social services whose training and outlook raises them above departmentalism and stimulates constructive thought about the place of their special work in the social services and policy generally, the formal training requirements of various departments or branches of the service are very narrow and overweighted by technical questions arising out of statutes, regulations and codes of instructions.

The report suggests that there is a real need for a comprehensive course of training in social case work to be taken by all who wish to engage in this career; and it is clear that, in this matter also, professional associations could offer a very useful contribution. Moreover, the report shows that there are very important spheres of social service in which, whether because of their experimental or controversial nature at the time, the exceptional freedom of opinion and experiment demanded for teaching or research, or the individual attention required for intimate personal problems, voluntary organizations are not only more appropriate but also may have essential functions to fulfil.

At a time when scientific workers generally are considering so closely the social consequences of their work, the P E P report not only provides a very stimulating survey of the field which indicates definite directions for further research, but also issues a challenge to really practical efforts which can scarcely be ignored by such workers if their interest in social affairs and social science is sincere.

History of Elementary Mathematics

Geschichte der Elementar-Mathematik in systematischer Darstellung:
mit besonderer Berücksichtigung der Fachwörter. Von Dr. Johannes Tropfke. Band 3: Proportionen, Gleichungen. Dritte, verbesserte und vermehrte Auflage. Pp. iv+239. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.) 10 gold marks.

ALL who are interested in the history of mathematics will be delighted to see that Dr. Tropfke continues to make progress with the publication of the third edition of this invaluable work which, in the form it took in the second edition, has long been an indispensable book of reference. It is nearly thirty-five years since the date of the preface to the first edition (summer 1902) in two volumes; the second edition, much enlarged and modified in arrangement, came out in seven volumes or parts between the years 1920 and 1924, and grew to a compass of nearly 1,300 pages in all. The third edition, in consequence of the mass of fresh material which has accumulated since 1924 through new discoveries and researches, bids fair to show an increase in size of one third or thereabouts. It is gratifying to find that each volume as it comes out brings the subject of it up to date. There are many references in the present volume to books and papers of date so recent as 1936. Some slight inconvenience will be caused by the fact that, owing doubtless to the amount of work involved, the volumes are appearing at considerable intervals—vol. 1 appeared in 1930, vol. 2 in 1933, and vol. 3 in 1937—so that, as each volume comes out necessitating a multitude of fresh references, the references in the earlier volumes also have to be added to or corrected. This disadvantage, however, is minimized by ingenious tables given at the end of each volume showing the correspondence of the pages in the second and third editions respectively, and the changes in the numbering of the various footnotes.

The subject of proportions takes up only one tenth of the volume, the other nine tenths being devoted to equations. This is because, with the gradual evolution of algebraical notation, the subject of proportions has come to occupy less and less space in original works and text-books. The Greeks, for example, had largely to use proportions and their transformations (by compounding, etc.) as a substitute for what we state and manipulate in the form of equations; in their 'geometrical algebra', this was the only means by which they could overcome the restriction of their work to not more than three dimensions. It was not until Heron's time that their treatment of equations became arithmetical enough to enable a number representing an area to be added to a number representing a length and so on, whereas the Babylonian, many centuries before, had done this without any hesitation. Beyond indications that the idea of ratio and proportion is found in Babylonian mathematics and in the Moscow Papyrus, the section on proportion shows little change from the second edition.

The history of equations is treated under the following heads: general historical survey, the distinction between the known and the unknown quantity, technical terms, equations of the first degree (*a*) with one unknown, (*b*) with more unknowns, equations of the second degree, 'reciprocal' equations, quadratic equations with more than one unknown, equations of the third degree and solutions of the same by algebra, geometry and trigonometry respectively, as well as solutions by approximation and by the method of 'false hypothesis' (*regula falsi*), equations of the fourth degree, equations of degree higher than the fourth, and lastly indeterminate equations including 'Diophantine analysis', etc.

The bulk of the new material which called for treatment in the new edition relates to mathematics before the time of the Greeks. Thanks to the new editions of the Rhind Papyrus by Peet and Chace respectively, to the publication by W. W. Struve of the Moscow Papyrus in 1930, and to the extensive discussion to which they have given rise, we are now in a much better position to judge of the scope of the ancient Egyptian mathematics. More important still, the publication by O. Neugebauer of Babylonian cuneiform texts of mathematical content going back to 1800 and 2000 B.C., and the books and papers that have been written upon them in recent years (by O. Neugebauer himself, Kurt Vogel and others), have thrown a flood of light on the achievements of the Babylonians in arithmetic and algebra. It is now shown that the Babylonians of those early days consistently used and manipulated with ease the sexagesimal system of numeration (including the successive sexagesimal fractions) necessitating the use of multiplication tables going up to 59 times 59; they solved quadratic equations by steps precisely equivalent to the use of the regular formulæ of our text-books, though without any statement of a rule and with no better technical terms for the unknowns (which we call x, y, z, etc.) than the words 'length', 'breadth', 'depth' and such-like written in full; some of their problems lead even to a type of cubic equation which can be put in the particular form $x^3 + x^2 = a$; one of these gives $x^3 + x^2 = 4, 12$ ($= 252$), and the solution $x = 6$ is merely stated, leaving us to speculate how it was arrived at, which would be a complete mystery but for the discovery of a table of sums of numbers of the form $n^3 + n^2$ for different values of n from 1 to 1,0 or 60. All these things are duly recorded in the volume before us, with very full references.

The dependence of the Greek solutions of quadratic equations on geometry, and ultimately on the discovery by the Pythagoreans of the method of 'application of areas', has long been known; but the specific connexion with propositions in Euclid (Book 2 generally and Props. 4, 5, 6 in particular, Book 6, 27–29, and Props. 84–86 of the "Data") is here treated at much greater length and much more fully elucidated with diagrams than it was in the earlier edition.

A word should be added about the appendixes. These include, besides the tables showing the correspondence between page numbers and note numbers in the third and second editions, three noteworthy features. (1) Chronological tables showing the gradual evolution of modern algebraical notation. (2) Original examples of the actual working-out of solutions of equations, from the Babylonians downward to Newton. These with their great variety of notations are fascinating to follow: there are seventy-two of them, and they include solutions by Al-Khwārizmī, Leonardo of Pisa, Regiomontanus, the authors of German and Latin MSS. of 1461 and 1481, Nic. Chuquet, Johan Widman, Luca Paciuoli, Grammateus (Heinrich Schreiber), A. Riese, Christoff Rudolff, Michael Stifel, Cardano, Johannes Buteo, Bombelli, Stevin, van Schooten, Kepler, Harriot, Fermat, Descartes and Newton. (3) Solutions by means of conics of the cubic equations, $x^3 = a$, $x^3 + bx = a$ from Omar Khayyām's algebra.

The book cannot be too strongly recommended.

T. L. H.

Mechanism of Growth in Plants

Growth Hormones in Plants
Authorized English Translation of "Die Wuchsstofftheorie und ihre Bedeutung für die Analyse des Wachstums und der Wachstumsbewegungen der Pflanzen". By Prof. Boysen Jensen. Translated and revised by George S. Avery, Jr. and Paul R. Burkholder, with the collaboration of Harriet B. Creighton and Beatrice A. Scheer. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiv + 268. (London: McGraw-Hill Publishing Co., Ltd., 1936.) 21*s*.

THIS book is very necessary, and has been well done. During the last decade, no field of work has been more popular among students of plants; the output of papers has been enormous. The field is very adequately covered in this book, which also contains a very extensive bibliography.

Prof. Boysen Jensen's original experiments demonstrating the continued phototropic curvatures of the base of the coleoptile after its tip had been cut off and then replaced when only this tip region was afterwards illuminated laterally, formed the basis upon which all this superstructure of experiment and theory upon growth regulation in the plant has since been erected, so that it is entirely appropriate he should be the author of this volume, which is now translated and revised by American workers in this new field.

Prof. Boysen Jensen is able to show that the theory that substances may be released from the apical tissue of the coleoptile and transported in some way to the elongating base of this structure, where they control the rate of elongation of the basal region, has rallied to its support a host of new experimenters with new methods; that analogous substances have been synthesized or extracted from such unlikely substances as urine; and that these substances are now suggested as essential parts of a general growth mechanism in the plant, regulating shoot growth and root growth, phototropic and geotropic response and, still more recently, suggested as controlling cambial activity.

The book covers very thoroughly, though necessarily very briefly, the whole of this wide field, and is most valuable, therefore, as presenting a clear, authentic picture of the range of experimental investigation in this new field. The first chapter contains a most ingenious double-page illustrated chart of the development of the new field of work, though this sketch, naturally brief, links Loeb with views from which he departed very widely in his later writings on regeneration.

Such a book as this naturally evokes an appraisement, in the mind of the reader, of the general effect of this new phase of activity upon our knowledge of the plant. The present reviewer in earlier years ventured into print as a sceptic of the new hypothesis: he has had to consider again in the light of this book whether he finds this view of the mechanism regulating plant growth convincingly established.

The strength of the case has always been the experimental demonstration, first given by Boysen Jensen, that the severed tip of the coleoptile, laterally illuminated, in some way so modifies the growth of the coleoptile base beneath, with which no living tissue connexion is left, that a phototropic curvature occurs in this basal region. Since that time a host of experimenters, associated particularly with the Utrecht school, have devised most ingenious experimental technique showing that substances which diffuse from the base of the excised coleoptile tips, and which may be collected on agar disks or in other ways, can modify the growth-rate of the coleoptile. Much has now been learnt of the growth of the coleoptile; throughout the period of phototropic response the growth is almost entirely by cell extension, not cell multiplication, so that a tendency has been to term this growth-modifying substance an auxine rather than a hormone, and much valuable work has been done on an analysis of the factors controlling cell extension; but it may be gathered from this review that as yet no definite conclusion can be drawn as to the way in which auxine or hormone affects this mechanism of cell extension.

The channels and mechanism of transport of the hormone from apex to base still remain mysterious, but in view of the state of our knowledge of water or food movement in the plant this is perhaps not surprising; the reviewer is still intrigued by the hypothesis that the growth regulator is secreted mainly by the apex of the coleoptile. There is a curious contradiction here that runs throughout this field of work. Investigators of the coleoptile have learnt to regard the growth-regulating mechanism as regulating cell extension, but their experimental results are freely quoted by investigators who are claiming growth-regulating effects on the meristematic tissues of buds or of cambia. Similarly, many investigators now report, in other plants, a distribution of the growth hormone which is correlated with the meristematic activity of the plant tissue, and yet this apex of the coleoptile, like most other monocotyledon leaf apices, is a region that has ceased to grow.

In this book Prof. Boysen Jensen repeats the curious argument that as a decapitated coleoptile begins to grow after a few hours, this must mean that there has then been a physiological regeneration of the tip from which growth hormones are again resuming their flow. The first experimenters to postulate this regeneration do not seem to have troubled to look to see if it occurred, and apparently the experimenter in this field is not interested in the fact that there is no visible regeneration. Fatty deposits accumulate over the cut stump, which ceases to bleed; no new cells are formed and no striking accumulation of protoplasm is visible in the cells below the injury. But it is not clear why regeneration is necessary; cells of the original apex were inert to all appearance, the cells below the cut surface are similarly so. It is one of the curious anomalies of this coleoptile story that the cells which are supposed to be most vigorously active in hormone production are conspicuously inactive in every other way, whilst the cells which will show most elongation during growth are situated in the part of the coleoptile farthest removed from them. The difficulty has been discussed by Went and others, and leads to further hypotheses, but the strength of the position of the author, and of the numerous botanists who think with him, lies in the fact that there is no alternative hypothesis which adequately explains basal curvature in the hypocotyl when laterally illuminated only at the tip, especially when that tip has been excised and replaced.

There may yet, however, be found some other explanation of this mechanism of stimulus reception and growth response, and at least until this mechanism is more fully understood some caution seems advisable in extending the hypothesis to cover growth mechanisms in general in view of the fatal facility with which a hypothesis can be constructed to explain anything, by postulating substances from unknown sources moving by unknown channels to work by unknown methods. The same mechanisms may apply in other growing systems as in the coleoptile—though meristematic tissues in dicotyledons may be expected to differ widely in behaviour from the vacuolating tissues of a monocotyledon leaf—but as yet we seem far from the stage when a satisfactory picture of growth regulation can be based upon our conceptions of such growth-regulating substances.

None the less, very interesting facts have emerged as to the action of some substances, in some cases chemically pure substances, in promoting callus formation on wound surfaces or in accelerating root production; and the rapidly growing army of workers in the new field, indicated by the extensive bibliography, is an ample guarantee that the possibilities of this new method of interpreting growth phenomena in the plant will be fully explored.

J. H. PRIESTLEY.

Metallurgy of Gold

The Metallurgy of Gold

By Sir Thomas Kirke Rose and W. A. C. Newman. (Griffin's Scientific Text-Books.) Seventh edition, revised throughout and re-set. Pp. xiii+561. (London: Charles Griffin and Co., Ltd., 1937.) 36s. net.

DURING most of the period covered by known history, gold has occupied a special position in the thoughts and affairs of men. It has been responsible for explorations, migrations, wars and conquests, and it was in efforts to obtain it by transmutation that the science of chemistry had its origin. Recent developments in civilization have been such as to require the use of increasing quantities of iron and steel, copper, aluminium and certain other metals, which have become increasingly important through their numerous applications at the same time as gold has tended to disappear into deposit vaults. Nevertheless, the position of gold is still unique, and the quest for it is scarcely less eager than in the past.

Other metals become more important as the number of useful purposes for which they can be employed increases. Gold, however, is scarcely affected by such factors, and although its present use is symbolic rather than tangible, it is being produced in larger quantities and sold at a higher price than at any previous time. Gold, in effect, is an economic instrument, and, unlike other metals, it passes out of the sphere of industry into that of economics and finance after it has been extracted from its ores and refined. This affects the metallurgy of gold, in that little attention is given to such aspects as alloying, fabrication, treatment and behaviour under different conditions of service, which are of great importance in the metallurgy of other well-known metals. Thus, in the book under review, most of the space is devoted, as it should be, to the plant and technique used and the phenomena involved in obtaining gold from its ores.

The book begins with an account of the physical and chemical properties of gold. This is followed by a description of the binary alloy systems formed by gold and a number of other metals. Many such systems have been studied, and some of them exhibit features of considerable scientific interest; but the only metals alloyed with gold for practical purposes are copper, silver, palladium, nickel and zinc. In the third chapter, the chemistry of the compounds of gold is considered, and the remainder of the book consists of fourteen chapters on the processes of crushing, grinding, concentrating, extracting and refining used in the metallurgy of gold, and three on assaying and ore testing.

In one sense, this book may be regarded as the seventh edition of a classic work the first edition of which appeared in 1894 and the sixth in 1915. In another sense, however, it is a new book, for the name of W. A. C. Newman appears for the first time on the title-page along with that of the original author, Sir Thomas Kirke Rose. The combination has proved very effective, for whereas the general plan of the book and much of the original matter have been retained, new chapters on flotation and ore testing have been added and the original chapter on chlorination omitted, while throughout the text as a whole new information has been included and obsolete matter deleted so as to present a balanced account of the subject as it is to-day. All this is very important, for standard works of this kind are, or should be, primarily intended for those who desire to learn something about the subject, and are not prepared to provide interesting reading for those who are sufficiently well informed to sort out the up-to-date information from that which applies to the past. Actually the present work is more up to date than most new editions of classic works produced after a lapse of time, and better arranged than a new book appearing for the first time.

J. M. R.

Geology in Engineering

Engineering Geology
By Prof. H. Ries and Dr. Thomas L. Watson. Fifth edition. Pp. vii+750. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25*s.* net.

THE fifth edition of this well-known work is to be especially welcomed in Great Britain, where geologists pay far less attention to the allied sciences than is the case abroad, with the result that we have not yet produced a book dealing with the application of geology to civil engineering problems—a position to be regretted.

The number of rock-forming minerals dealt with in Chapter i is rightly reduced to the bare minimum required by engineers, some two hundred pages on rocks and their structural features following. Rock-weathering and soils, treated in Chapter iv are probably of less importance to engineers than is realized by the authors, while the treatment of run-off is disappointing, since this offers a ready, and so far untapped, field for the application of precise geological methods. It is, however, a relief to find a book which does *not* give Stokes's law for the elutriation of sediments. The section dealing with sub-surface waters is extremely interesting, and goes to show that a great deal more work has been done on this branch of the subject in the United States of America than in Great Britain.

Landslides are discussed adequately in Chapter vii, the matter on wave action being less closely linked with civil engineering practice. Lakes and glaciers are quite briefly treated. The geology of reservoir and dam sites is well covered in Chapter xi; but some of the recent work on building stones, both here and abroad, is not mentioned in the following chapter, which is otherwise ample enough.

The technology of limes, cements and plasters is so varied that one is not surprised to find it described briefly in eighteen pages, and this is also true of the clays and clay products treated in fourteen pages. It is obvious that a book which goes on to deal with coal, petroleum and natural gas, ore deposits and the outlines of historical geology, requires considerable ingenuity on the part of the authors as to what to include and what to omit, so that the allocation of only fourteen pages to road materials, a subject the importance of which has greatly increased in recent years, is quite understandable. In a later edition, perhaps, the application of recently developed microscopic methods might be added to this portion with advantage.

This work can be recommended to the student of civil engineering and to the practising engineer as being certainly one of the best, if not the only one, of its kind.

B. H. Knight.

The Mechanism of Nature

being a Simple Approach to Modern Views on the Structure of Matter and Radiation. By Prof. E. N. da C. Andrade. Revised and enlarged edition. Pp. xii + 188 + 8 plates. (London: G. Bell and Sons, Ltd., 1936.) 6*s.* net.

THIS book is chiefly intended for the man who has not had the advantage of a scientific education but is anxious to know something of modern scientific developments. There are no mathematical formulæ to put the reader off. Sir James Jeans says somewhere that without considerable mathematical knowledge it would be quite impossible for anyone to understand those branches of science which deal with the fundamental nature of the universe, as, for example, the theory of relativity, the theory of quanta and wave mechanics. So the reader must not expect to be able to do this unless he be a well-equipped mathematician. Prof. Andrade, however, is so skilful in the use of words that his statements impart all there is to know on these subjects short of the employment of mathematics.

In this, the fifth edition, the whole book has been revised and alterations and additions have been introduced to bring it into harmony with recent work. The treatment of cosmic rays has been modified to accord with advances made since the last edition, and a brief account is given of the recent discovery and meaning of heavy hydrogen, the neutron and the positron, of artificial radioactivity and the striking development of artificial transmutation of matter. The explanation of the cause of isotopes—substances which have the same chemical properties but different atomic weights—is of much interest; 'heavy hydrogen' is the most remarkable of these. Another matter of interest is the question of how artificial atomic transmutation was brought about, to which Lord Rutherford has contributed so much. It has, however, so far never produced weighable quantities of any new atom, but established the possibility of transmutation. This, of course, completely revolutionizes the classic ideas of the nature of the atom. All these are treated with admirable clearness by the author, who is a master of exposition where complicated matters are concerned. H. L. C.

Aftermath:

a Supplement to the Golden Bough. By Sir James George Frazer. Pp. xx + 494. (London: Macmillan and Co., Ltd., 1936.) 21*s.* net.

IT might seem that the twelve volumes of "The Golden Bough" had already covered the ground more than adequately, and stood in no need of a supplement. Here, however, the author has gathered together data, not numerous, which had escaped his attention previously, and the more important items of evidence bearing upon his arguments, which have accrued in field work since the publication of the last edition of the major work. Hence this new volume is a corpus of additional facts, corresponding in its division into chapters with the arrangement of topics in "The Golden Bough", but making no addition to theory, except by way of corroboration. Much of the material will already be familiar to anthropologists, who have not failed to note on numerous occasions how investigations in these fields of inquiry have served to confirm interpretations first tentatively suggested in "The Golden Bough". Prof. Seligman's Frazer Lecture dealing with the magical ritual of kingship, of which his own investigations among the peoples of the Upper Nile formed the starting-point, affords perhaps the most striking instance of the prescience shown by Sir James, not once alone, but on many occasions.

Notwithstanding advancing years, the hand of Sir James has not lost its cunning. His latest work in no way falls behind its many predecessors in style and charm of diction.

Marconi:

the Man and his Wireless. By Orrin E. Dunlap, Jr. Pp. xxii + 360 + 16 plates. (New York: The Macmillan Co., 1937.) 16*s.* net.

THE author gives a good and temperate account of the life-work of one of the world's greatest inventors. One of the early pioneers of radio attributed Marconi's success chiefly to his instinctive intuition as to what was wanted and the best way of getting the solution. It must not be forgotten that he had a company with plenty of capital behind him and that its success or failure depended upon the rapid development of radio in the early days. With this money behind him he had the courage to launch out on great experiments. The fact also that the organization was called the Marconi Company added greatly to his prestige and always kept his name prominently before the world. When 'Cables obtained control of Wireless' in England, and the Marconi Company became practically a manufacturing organization, the most interesting period of its life had passed.

The author describes both the 'man' and the 'inventor', and links them together into one personality. Marconi crossed the Atlantic eighty-nine times on voyages of scientific research and good will. This view of him from an American angle throws much light on his career. We hope that it will not become customary in the United States to refer to Oliver Heaviside as Sir Oliver Heaviside.

Hardness of Metals

By Dr. F. C. Lea. Pp. vii + 141. (London: Charles Griffin and Co., Ltd., 1936.) 12*s.* 6*d.* net.

THE hardness of metals, as Dr. Hugh O'Neill once said, like the storminess of seas, is easily appreciated but not readily measured. Prof. Lea has attempted to describe the various methods of measuring hardness, to establish, from the results of a long series of tests, the relationships between hardness measured by each of these methods, and thence, by means of curves and a chart, to make it possible within certain limits of accuracy to obtain corresponding hardness numbers as determined by the various methods. The book is not so much a discussion of 'the hardness of metals', therefore, as a collection of hardness data obtained on a series of materials comprising chiefly heat-treated steels.

Boucher de Perthes and the Foundations of Prehistoric Archæology

PREHISTORIC archæology, being one of the younger among the sciences, has had few opportunities of celebrating centenaries. It is a little more than a hundred years ago that the excavation of Kent's Cavern, Torquay (1825–29), first afforded a warrant for the tentative suggestion that man had lived in some remote past as a contemporary of an extinct mammalian fauna. Until this coexistence was demonstrated conclusively, discussion of the antiquity of man had no solid factual basis of inference on which to proceed. For this reason, Boucher de Perthes, on account of his discoveries of flint implements in the valley of the Somme, derived from geological horizons in which they were shown to be associated with the fossilized remains of extinct mammals, has been regarded as the founder of prehistory, and more especially of that branch of archæological studies which deals with the industries and cultures of the Old Stone Age.

It was in August 1837, according to his own record made not long afterwards, that Boucher de Perthes initiated his investigations of the geological deposits of the Somme valley for evidence of early man, and acquired the first objects in his collection. There is reason for thinking, however, that the correct date may have been in the following year. In fact, if Boucher de Perthes's statements be accepted, it is difficult to follow the course of events, or arrive at a just estimate of the credit to be assigned to him in the crucial discoveries in the later 'thirties and the 'forties of the last century.

In 1837, Boucher de Perthes was neither archæologist nor geologist. On his return to Abbeville from Paris in 1830, he was known only as an unsuccessful writer of satirical drama and a tendentious political economist, who had been expelled from the public service on account of his radical views; while up to 1841 he was immersed in the publication of a vast work entitled "La Création" on metaphysics, a subject in which, on his own showing, he had never read a word, and in which he relied not so much on his reason as his imagination. Writing in 1863, he claimed that so far back as 1805, when as a youth of seventeen he visited the Cave of Roland at Marseilles, and again in the Papal States in 1810, the idea of discovering evidence of man as a contemporary of extinct mammals had been before him. But in making this claim, as well as others for an early dating of his views on the antiquity of man, his recollection was coloured by after events. These dates cannot be substantiated. His memory was highly imaginative, and he verified neither his recollections nor his dates.

Recent research in the early records of archæological studies in France has shown that prehistory, unlike Minerva, did not spring full-fledged from a single head. In Great Britain, the discovery of flint implements at Hoxne by John Frere in 1797 gave a lead; similarly, in France from the early years of the nineteenth century, archæological discovery, as for example in the work of Jouannet in Perigueux, was pointing the way to the recognition of primitive phases in the development of civilization transcending by far the time limits then fixed by archæologist, palæontologist and geologist alike, whose vision for the time being was bounded by the views of Cuvier on the recent origin of man.

The apparent paradox of Boucher de Perthes's achievement as the founder of prehistory by his discoveries in the valley of the Somme, when contrasted with his character, attainments and previous history, has led M. Aufrère of the Institut de Géographie in the University of Paris* to examine not only his published works and correspondence, but also the drafts of his writings and letters with their numerous deletions, alterations and amendments, as well as the records of scientific activity at Abbeville at that period among those with whom Boucher de Perthes and his father before him were in touch. The result has been to throw an entirely new light on the course of events, and to give a new orientation in the investigations made by Boucher de Perthes, while meting out justice to the inspiration to which they were due.

The story begins with the foundation of the Société d'Emulation at Abbeville in 1795. Of the original members the most distinguished was Emmanuel Baillon, who had been of signal assistance to Buffon in his great work on natural history by his accurate observation of birds. Five years later, Cuvier was elected a member, and the announcement of his election was accompanied by a box of fossil bones of mammals found by the members in the neighbourhood of Abbeville. Cuvier's influence on the ideas and pursuits of the members of the society was considerable, especially in the domain of geology and palæontology. His view of the recent origin of man largely determined their attitude in discussing archæological material.

* Le Mouvement Scientifique à Abbeville dans la Première Moitié du XIXme Siècle et les Origines de la Préhistoire (1795–1840). Par L. Aufrère. Sciences, Assoc. Fr. pour l'Avmt. des Sciences. No. 4, 1936; Essai sur les Premières Découvertes de Boucher de Perthes et les Origines de l'Archéologie Primitive (1838–1844). Par L. Aufrère. Epreuves et Synthèses, No. 1. (Paris. L. Staude, 1936.) Also other papers.

This accounts for the readiness of Boucher de Perthes and others to maintain, or, on occasion, revert to, the view that the stone implements discovered in the Somme deposits, like those found elsewhere, were 'Celtic'.

In the work of the fifty years which followed the foundation of the society, closing in 1844–45 with the presentation of the account by Boucher de Perthes of his discoveries, the achievement of certain of the members stands out. Of some of these only a brief mention must suffice.

The first in chronological order is Laurent Traullé (1758–1828), palæontologist and archæologist, wild in theory, but excellent in observation and discovery. It was he who supplied Cuvier with the fossil remains of elephant, rhinoceros, Bovidæ, horse and deer. He was the finder, in 1814, of a 'Celtic' hafted axe; but his most noteworthy contribution to archæology was the recorded observation of the stratified cultural sequence in the deposits of 'Celtic', Roman and 'Francisque' in this invariable order—an observation pregnant for archæology, albeit unfortunately forgotten until revived more than twenty years later. Most important of all, however, was his account of the stratification of the geological deposits of the Somme valley, the first of its kind.

Of those who were working at Abbeville in the years preceding Boucher de Perthes's investigations, two names to be noted are those of Alfred Tillette de Mautort and Dr. F. P. Ravin (1795–1849); both careful observers of geological evidence, whose detailed accounts of stratification in recording archæological finds brought archæology and geology into intimate relation. Dr. Ravin's authoritative records of geological formations were later to prove of much value to Boucher de Perthes, who made use of his specialized knowledge to support and authenticate his own observations.

The full implication of the relation between geology and archæology in the work of Ravin and de Mautort was developed by Casimir Picard, a name that has been forgotten, but deserving a better fate as that of an outstanding personality in the scientific, and more especially the archæological, activities of the Abbevillians between 1830 and 1840. Picard was born at Amiens in 1806, and went to Abbeville from Paris as a qualified medical man in 1828. Widely interested in scientific pursuits, but especially botany, palæontology and geology, he had unbounded energy, and on attaining office in the Société d'Emulation rapidly spurred that body to strenuous activity. He was associated with Boucher de Perthes in the organization of the Abbeville Museum, an association which, as M. Aufrère suggests, may have been responsible for the foundation of prehistory. His powers of lucid and cogent archæological argument were far in advance of his time, and would stand the test of modern application. In fact, his contributions to archæological theory went far to lay the foundation of archæology as a science. Of these, the more important were the rehabilitation of the flaked implement as something more than an unfinished stage, or a reject in the manufacture of a polished implement, as was then held; the demonstration of the relation of core, or nucleus, and flake as correlatives in the technique of flint fracture; and the argument from stratification for the contemporaneous character of deposits and contained artefacts, and hence the inferred coexistence of man and extinct fauna as contemporaries.

In May 1838, Picard presented a preliminary sketch of a report on the antiquities of Abbeville to be prepared in response to an official request. From this it appears probable that he had in mind a project for a series of excavations and investigations in the neighbourhood of Abbeville. Unfortunately, pressure of other interests, such as the foundation of the Linnean Society of Northern France in 1838, drew him away; and three years later, in March 1841, he died at the early age of thirty-four years. Had his life been prolonged, there can be no doubt that the early history of prehistoric discovery in the Somme valley would have been far different. His precision and appreciation of scientific method would have averted the ineptitudes which delayed the acceptance of Boucher de Perthes's very considerable contribution to the advancement of knowledge.

Picard's archæological insight and his enthusiasm, however, were not to be without effect. On more than one occasion Boucher de Perthes recorded that his investigations, whether beginning in 1837 or in 1838, were first undertaken, with some reluctance and even distaste on his part, in order to continue the work which Picard had planned, and no doubt hoped to carry out himself. His death took place before he realized that anything but a 'Celtic' antiquity was involved, and that his plan of campaign, if it produced any result at all, would lead to the discovery of diluvial man. Nor was Boucher de Perthes, in his earlier investigations at La Portelette, Menchecourt and the Hôpital site, in better case. So far from appreciating that his aim, as he afterwards claimed, was fossil man, it was some time before the distinction, which appears on the title-page of his capital work, between "antiquités celtiques" and "antiquités antédiluviennes" was presented to his mind. Unfortunately, when the reported occurrence of pottery and stone implements, especially of axes, which first appeared in 1841, convinced him, though he had not seen these finds *in situ*, that he was dealing with diluvial man, the heterogeneous character of the finds, which included Venetian glass, as well as knives and axes of stone which would now be termed neolithic, only provoked ridicule when submitted to expert examination. Boucher de Perthes then reverted to the idea that they belonged to a 'Celtic' civilization, though still maintaining their association with an extinct fauna. It was not until 1843 or 1844 that he saw, *in situ*, the first of the axes, now to be regarded as Lower Palæolithic, which confirmed his contention of the existence of diluvial man. This find from the Hôpital site heralded the evidence which, notwithstanding such vagaries as a large proportion of fractured flints of non-human origin, and a collection of so-called representations of animal forms, was to win a verdict in his favour from the British commission of inquiry of 1859.

So far as the foundation of prehistory was the outcome of anything like a scientific conception of the aims and methods of archæology, the credit belongs to Picard rather than to Boucher de Perthes; but to the latter must be conceded a tenacity of purpose which carried through the actual investigation and won recognition in the end.

The Proposed Everglades National Park, U.S.A.

By Dr. John Kunkel Small, New York Botanical Garden

THE proposed Everglades National Park, recently authorized by the Congress of the United States, after thirty years agitation, is of importance to all who are interested in outdoor life. Its area (capable of enlargement) of two thousand square miles is less than that of several national parks in the United States and elsewhere; but it surpasses in the abundance, variety, and activity of plant and animal life. In most large parks life is in a decline. Variety is giving way to uniformity. Erosion is tearing down mountains; species are disappearing; plant and animal life is maintained with difficulty in increasingly artificial conditions. Such is not the case in the Everglades. Both at the outer fringes of mangroves and far within, land is naturally and continually increasing. Life in the warm humid climate is luxuriant, active—primeval, as if species were making. Plants and animals live as they have for ages, and as they may continue to live for years to come.

The area (Fig. 1) is not technically within the tropics, but the Tropic of Cancer lies only seventy-five miles distant, and ocean currents, prevailing winds, and migratory birds have found a strictly tropical rendezvous scarcely surpassed anywhere in congenial conditions and lack of disadvantages. The area is about equally divided between land and water. The highest points of land are scarcely ten feet above tide, and the water has an average depth of but a fathom or so. Most of the area is accessible by boat in protected waters, a mode of transportation least disturbing to wild life. However, when roads and trails are desirable they can be built at little expense.

ANIMAL LIFE

There are few places where marine life is so abundant and active; the greater part of it is in continuous motion and change, either anchored or free swimming. On one hand, this fact can be observed and studied in the shallow crystal-clear waters of the vast continental shelf on which the Florida Keys now stand and which fringe the mainland. These waters are teeming with life, in almost innumerable quantities and variety. A handful of mud from a bleak and lofty area like the United States Great Smoky Mountain Park will remain motionless; a handful from the Bay of Florida will be in continuous motion as a result of the included active marine life. The kinds of lowest animals—sponges, jellyfish, corals, sea-anemones, moss-animals, molluscs, sea-urchins, sea-cucumbers, starfish and stone lilies—are legion.

Associated with these, fish of almost innumerable kinds, forms, and colours, and great range in size, abound in the waters, fresh and salt. The vast numbers of fish may be realized by the fact that the schools are often so large that they fill bays and sounds to the exclusion of a great part of the water.

Ascending in the life-scale, we find amphibians and reptiles. Frogs abound. Several kinds of large turtles are found, and the alligator and the crocodile are outstanding. Among serpents is the dangerous cotton-mouth moccasin and the largest and most dangerous American reptile, the diamond-back rattlesnake, which sometimes attains a length of nine feet. Lizards are numerous, but most of them are small.

More evident than the amphibians and reptiles are the birds. The bird life of this region is prodigious, ranging from the minute humming-bird to the wood ibis and the golden eagle. Naturally, from the make-up of the country, both land and water birds abound. The latter are often seen in greater abundance. As a result of their feeding habits—diurnal and nocturnal—flocks of innumerable birds, like flakes of snow in a storm, may be seen in flight both day and night. The sight of their going and coming between the feeding-grounds on a bright moonlight night, not to mention the uncanny noises of their cries and the swish of wings, is something never to be forgotten. Black and various colours of plumage are continually seen. Very conspicuous are the white and pink ibis and the rare roseate spoonbill, of which thousands, even hundreds of thousands, were formerly seen at a time. The well-known egret is a decorative associate. The smaller highly coloured migratory birds pass this way, and are evident in season at this midway station.

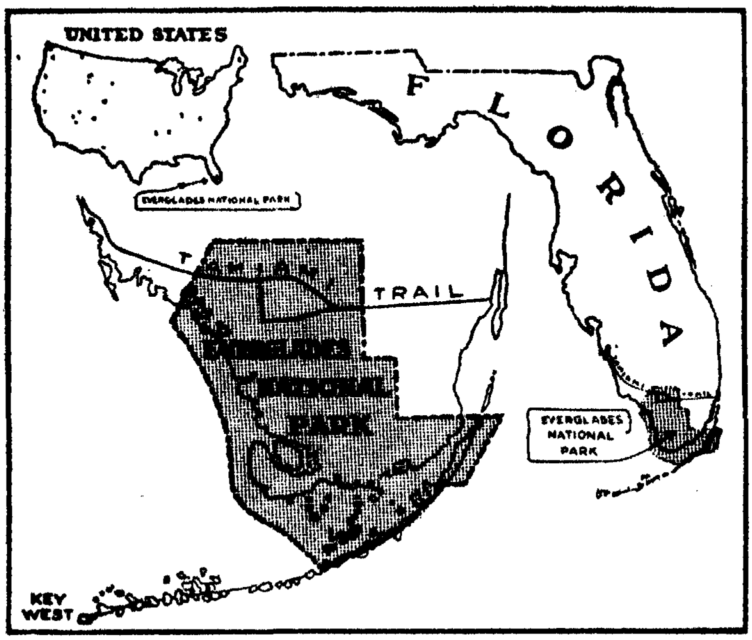

Fig 1.
THE PROPOSED EVERGLADES NATIONAL PARK.

On the land, one finds the insects universal as well as yet innumerable. The numbers of kinds can be only roughly estimated. Fascinating and grotesque forms may be seen everywhere. A short description of them would fill volumes. Many of the kinds are almost or quite microscopic; but large and ornate butterflies and moths abound. Less graceful but fascinating are the devils-horses, a showy grasshopper commonly six inches long which travels over the land by the million devouring vegetation as it goes.

Mammals are present on the land and also in the water. Several species of the large quadrupeds of eastern North America roam through the wilderness. Prominent among these are the panther, lynx, bear, deer. Curiously enough, the otter lives here just as it does in the Hudson Bay region. The larger aquatic mammals are the massive sea-cow and the whale.

PLANT LIFE

Broad-leaved vegetation is the most evident form of plant life to the casual observer, whether it be in swamp, prairie, or hammock; but underneath it grow ferns and flowering plants bewildering in attractiveness and variety. In this tropical wilderness, vegetation grows to its full stature and natural age without interference from man. It is true the destructiveness of Nature is rampant; but it is normal and in its way orderly. Plants and animals grow rapidly and soon return to dust, a process hastened here by a moist warm climate and the presence of a host of fungi and bacteria ever ready to do their work. In spite of the natural inroads, as the source of supply is inexhaustible, the flora is maintained while the land gradually rises higher and higher above the tides.

In the Everglades, tropical vegetation dominates; but the ranges of north temperate trees dovetail with those of the West Indian tropics. The north temperate elements have extended southward through the hammocks and along the cool waters of the prairies. The tropical ones have been brought beyond the tropics by the warm ocean currents, the winds, and the birds; and thus plants of opposite temperature requirements mingle, and there is a unique balance in life-forms.

Withal it is a strange country, a land of anomalies and the grotesque. Here fish sing*; snakes often live in trees; epiphytes grow as terrestrials; terrestrials grow as epiphytes; giant oak trees are arbours for aerial plants and ferns; cacti grow in water; oysters grow on trees that dip into the creeks; large pine trees and broad-leaved trees grow on rocks lacking soil; fig-trees grow as petriphytes trying to strangle the rocks; giant palms more than a hundred feet tall and cactus trees thirty feet tall grow as humus-plants; strangler figs kill other trees, and often turn upon themselves and commit suicide.

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* On the reef small fish attach themselves to the hull of a boat after dark and give off their plaintive notes all night long.

Bioclimatic Zones of Australia[*]

By Dr. J. Davidson, Waite Research Institute, University of Adelaide

TEMPERATURE and moisture are the chief factors affecting the physical environment of terrestrial plants and animals. In association with soil type, they exert a dominating influence on geographic distribution and seasonal abundance. In Australia, moisture is the chief limiting factor; temperatures during winter are moderate, the mean for the coldest month being above 43° F., except in parts of Tasmania and the highlands of Victoria and New South Wales. The essential elements of climate, on which the availability of moisture depends, are precipitation and atmospheric humidity; loss of moisture by evaporation influences the effectiveness of precipitation.

During recent years, attempts have been made by various workers in climatology to develop a formula by means of which the efficiency of rainfall may be assessed in relation to the moisture requirements of plants and animals. These investigators have taken into account the influence of temperature and atmospheric humidity on the rate of evaporation from an exposed surface. The simplest formula is the ratio proposed by A. Meyer in 1926, in which precipitation is related to evaporation by dividing annual values for rainfall by appropriate values for atmospheric water vapour saturation deficit, both expressed in inches or centimetres. Annual values for these elements are inadequate for bioclimatic studies, particularly in Australia, owing to the seasonal character of the rainfall and its unreliability over the greater part of the continent.

It is recognized that the best index to the relationship between climate and moisture at the soil surface is the ratio of precipitation to evaporation, the critical value being $P/E = 1$; with decreasing values dryness increases, with increasing values wetness increases. Unfortunately, suitable records for evaporation are available at comparatively few stations.

Where adequate data for temperature, rainfall, atmospheric humidity and evaporation are available they can be used to interpret the moisture and temperature 'conditions' in the environment of plants and animals. From the point of view of ecology, zones in which the essential elements of climate can be assessed in this respect may be defined as 'bioclimatic zones'. The flora and fauna of the different zones may be related to similar or different environments. This emphasizes the significance of environment, in contrast with the conception of phylogenetic grouping of animals, implied in the boundaries of the faunal regions of the world as defined by Alfred Russel Wallace. The term 'bioclimatic zone' was used by A. D. Hopkins (1921), who considered temperature to be the most trustworthy guide to the range of the zones. Experimental work since that time has abundantly demonstrated that temperature alone does not give a true index to the effect of climate on the flora and fauna of an area; the index must express the effect of moisture and temperature working in combination.

I employed the Meyer formula as a monthly ratio (P/Sd) in order to assess the degree of wetness or dryness over Australia, month by month. For this purpose, P/Sd was interpreted in terms of evaporation, (P/E) by reference to records for evaporation at the capital cities. Values for P/E were computed for 235 stations in the Commonwealth. The continent was divided into areas showing the areas and months in which values for P/E are greater or less than 0·5; the value 0·5 was selected tentatively as the minimum value, below which adequate moisture will not be available for general plant growth. The areas were grouped to form the five moisture zones defined in Fig. 1. For each of these zones it is known how many consecutive months have values for P/E greater than 0·5.

The intensity of dryness in any zone depends upon the number of consecutive months that values for P/E are less than 0·5, together with the value of the ratio. The intensity of wetness in any zone depends upon the number of consecutive months in which values for P/E are greater than 0·5, and the value of the ratio. In the central portion of Fig. 1, values for P/E are less than 0·5 for every month of the year; the region is classed as an ecological 'desert', the vegetation is characterized by acacia - semi-desert, shrub steppe and porcupine grass climax associations. The boundaries of this region, as shown in Fig. 1, differ somewhat from those obtained by employing the climatic relationships of desert areas as interpreted by Köppen (1923). The arid regions are defined as having one to six consecutive months in which P/E exceeds 0·5; they have been grouped to form the arid and semi-arid zones. The humid regions are defined as having seven to twelve consecutive months in which P/E exceeds 0·5; they have been grouped to form the semi-humid and humid zones. It is of interest to note the small area of Australia, north of the Tropic of Capricorn, which falls in the humid zone.

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[*] This article gives the chief features of a series of four papers by the author dealing with certain aspects of bioclimatology (*Trans. Roy. Soc. S. Aust.* 1934–1936); under the same title, it formed the subject of a paper given at the Auckland (1936) meeting of the A.N.Z. Ass. Adv. Sci. (Section D, Zoology).

The temperature zones have been defined on the following basis:

A. *Hot*—the mean annual temperature exceeds 70° F.

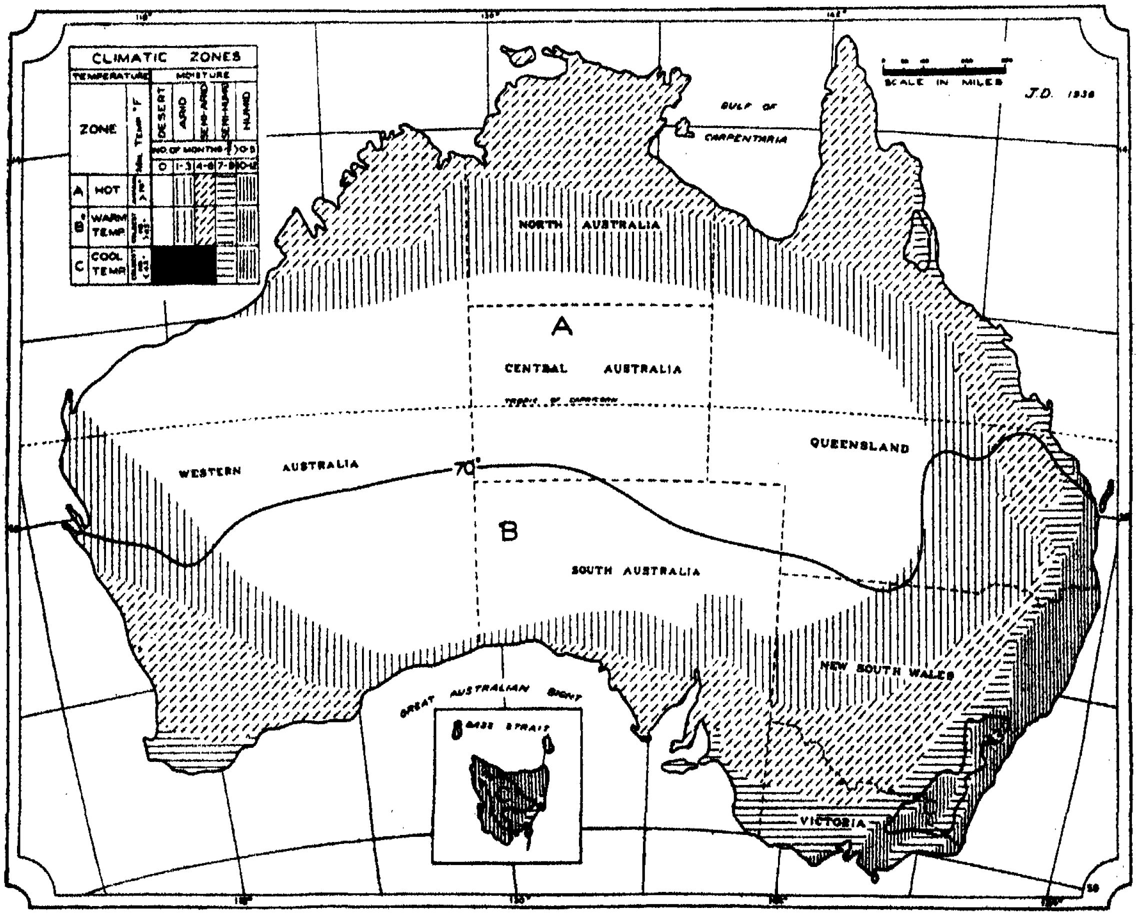

Fig. 1.

B. *Warm Temperate*—the mean temperature for the coldest month does not fall below 43° F.

C. *Cool Temperate*—the mean monthly temperature may fall below 43° F. during one to five months of the year.

In local areas at high elevations in Zone *C*, the average monthly temperature may fall below 43° F. for more than five months; these areas may be classed as having a cold climate.

The methods described above give a good index to the climate in the different zones; improvement in detail will be obtained when allowance can be made for the influence of additional factors affecting evaporation, such as air movements. The boundaries of the various zones appear to give a better fit to the actual climate in the zones than those developed by Thornthwaite (1933), who assessed "*precipitation effectiveness*" by evaluating the P/E ratio from data for rainfall and temperature.

There is a close agreement between the bioclimatic zones shown in Fig. 1 and the distribution of types of native vegetation; also there is a correlation between these zones and the distribution of areas where particular agricultural crops are grown, and the sheep and cattle carrying capacity of the pastoral country. This has an important bearing on the question of settlement in Australia. The methods may be useful as a means of obtaining an estimate of the potential population of the Commonwealth, on the basis of land utilization and production.

It is easier to assess the influence on plants, than on animals, of the physical environment as determined by climate. This is particularly so with active vertebrates which can readily move away from adverse local conditions.

Obituary Notices

Prof. E. B. Elliott, F.R.S.

PROF. EDWIN BAILEY ELLIOTT, sometime Waynflete professor of pure mathematics in the University of Oxford, honorary fellow of the Queen's College, and formerly fellow of Magdalen College, died at Oxford on July 21 at the age of eighty-six years.

Prof. Elliott was the son of Mr. Edwin Litchfield Elliott, of Oxford, and was educated at Magdalen College School, from which he obtained a demyship at Magdalen College. He took his degree in 1873, after obtaining first classes in mathematics, both in Moderations and in the Final School, and in 1875 was awarded the senior university mathematical scholarship. In 1874 he was appointed fellow and mathematical tutor at the Queen's College, holding the office for nearly twenty years, until in 1892 he was elected to the Waynflete professorship of pure mathematics, and so returned to Magdalen as a fellow. He resigned the professorship in 1922. He joined the London Mathematical Society in 1875, and was for a long time an active member, serving on the Council for many years beginning from 1882; he was president of the Society in 1896–98, being preceded in the chair by Major MacMahon and followed by Lord Kelvin.

All his life, Prof. Elliott produced a steady flow of papers giving the results of his investigation and research. They are to be found in the *Proceedings of the London Mathematical Society*, the *Quarterly Journal of Pure and Applied Mathematics*, and the *Messenger of Mathematics*. His chief work was done in the algebra of invariants, but he also published important papers on Frullani's integrals, on other definite integrals, and on differential invariants.

When Sylvester went to Oxford as Savilian professor of geometry, in succession to H. J. S. Smith, he was full of his theory of reciprocants and of the transformation of differential operators, a theory very much akin to Sophus Lie's theory of continuous groups. Under the influence of Sylvester's enthusiasm, Elliott wrote a paper "On the Interchange of the Variables in certain Linear Differential Operators" (*Phil. Trans. Roy. Soc.*, 1889). He was elected a fellow of the Royal Society in 1891.

His great work, "An Introduction to the Algebra of Quantics" (first published in 1895, second edition, 1913), made Elliott's name well known to all English mathematicians, and thirty years ago was a textbook for all students of higher algebra. He says in the preface, "The primary object of the book is that of explaining, with all the clearness at my command, the leading principles of invariant algebra. . . . Lucidity in mathematical works has often suffered from undue compression. My constant aim has been to guard against such a possibility here. . . . The title 'Algebra of Quantics' is perhaps one of my own introduction. It probably needs no defence, and can scarcely fail to convey the right meaning. The mathematical world has now for half a century associated the algebra of invariants and co-variants with the name of Cayley and with his 'Memoirs on Quantics' so that it may perhaps be regarded as appropriate that a new work appearing in a year which has seen the close of the labours of the renowned author of these memoirs, and dealing with their subject, should bear a name which recalls his memory".

It is interesting to note that in the "New English Dictionary" there are three quotations under the word "Quantic", the first being from Cayley (1854) whilst the last stands thus "1896. E. B. Elliott. (title) An Introduction to the Algebra of Quantics". The book is a masterly exposition of results due to Cayley and Sylvester, and of those due to Salmon, MacMahon and Elliott himself.

Elliott's last published paper (*J. Lond. Math. Soc.*, 1; 1926), which bore the title "A Simple Exposition of some Recently Proved Facts as to Convergence", was a proof of Hardy's theorem that if b_n denote the arithmetical mean of the positive numbers, $a_1, a_2, a_3 \ . \ . \ . \ a_n$, and $k > 1$, then

$$\sum_1^n b_r^k \leqslant \frac{k}{k-1} \sum_1^n b_r^{k-1} a_r \leqslant \left(\frac{k}{k-1}\right)^k \sum_1^n a_r^k.$$

This was an inequality of great interest to all workers in the theory of convergence, and Elliott's proof was greeted with enthusiasm by Hardy as the best, and in fact the last, word on the subject.

All who have studied mathematics at Oxford in the last forty years will feel that they have lost a friend now that Elliott is gone. He was always ready to help and encourage his younger colleagues with criticism and advice, and mathematics at Oxford owes him a great debt. A. L. DIXON.

Prof. P. Gardner

PROF. PERCY GARDNER was born on November 24, 1846, and passed away on July 19 last, after a few days illness, interested almost to the last in ideas, persons and things, and above all, in his friends. He was educated at the City of London School, and after a year's experience of business went to Christ's College, Cambridge, where he graduated with first-class honours in the Classical and in the Moral Sciences Tripos, and was elected a fellow in 1872. He had already entered the British Museum, and under great chiefs, Lane Poole and Barclay Head, spent fifteen years in a remarkable combination of metrological and æsthetic studies which determined his outlook on antiquity, while it earned him European repute. In 1877 he visited Greece, at a stirring time; Mycenae and Olympia had been excavated; there was talk of work at Pergamon, and even around the Acropolis of Athens. In 1880 he was appointed Disney professor of archæology at Cambridge, concurrently with his museum work; and it was with this double experience that he entered on his professorship of classical art and archæology at Oxford in 1887. Since 1880, too, he had been one of the original editors of the *Journal of Hellenic Studies*, and responsible for the high standard of scholarship and wide scope at which it aimed.

Classical archæology was in its infancy in 1887 as an academic subject in Oxford. Gardner's only predecessor, Sir William M. Ramsay, had been interested in exploration and in epigraphy, and had spent much of his time in travel. There were valuable collections, the 'Arundel Marbles' and the like from seventeenth century patrons of learning; and the new Keeper of the Ashmolean Museum, Sir Arthur Evans, was accumulating new materials in classical as well as prehistoric archæology. But there were few books, no casts or place for housing them; for a disastrous bargain had glutted the University Galleries with replicas of the works of Sir Francis Chantrey. But even before the reorganization of the Ashmolean Museum, and as part of a comprehensive plan, originals were installed, casts were acquired, and a modest work-shed was provided. Gardner's own conviction, bred of museum experience, and illustrated by his monumental "Numismatic Commentary on Pausanias" (1887), that in ancient coins we have a compendious and inexhaustible series of miniature illustrations of all aspects of Greek art, as well as of religious belief and local tradition, gave him initial advantage in planning his academic programme under such conditions, and in dealing with such early pupils as Sir George Hill and Dr. J. G. Milne. The breadth of Gardner's interests at this time is illustrated by his share in a collaborated "Manual of Greek Antiquities" (1892); his judgment and critical taste by his "Catalogue of the Ashmolean Vases" (1895) and "Sculptured Tombs of Hellas" (1896), and his deep philosophic interest in æsthetic problems by his "Grammar of Greek Art" (1905). As pupils became more numerous, systematic publication was less frequent, especially since there was no departmental staff, and only occasional lectures by college tutors supplemented the professor's own teaching. For many years, Gardner did the work of a college tutor for all his men, as well as his own. But he was a frequent contributor to the *Numismatic Chronicle* and the *Journal of Hellenic Studies*, and remained an editor of the latter until 1926.

It was during this later period too, from the publication of "Exploratio Evangelica" in 1899, that he allowed himself to give expression to his profound interest in the critical and historical aspects of early Christianity, in regard to which he combined what were then advanced liberal views with a simple reverence and personal piety which commended his scholarship and philosophical outlook to a wider circle of readers. From 1915 until 1923 he was president of the Modern Churchmen's Union, and remained an intimate and trusted counsellor of theologians of many schools. Though he took little public part in university business, he was a convinced advocate of research as an essential of university training, and of facilities for it after graduation; and his "Oxford at the Cross Roads" (1903) expressed frankly and strongly what only a few of his colleagues had then begun to envisage clearly, still less to advocate or practise.

In 1925 Gardner retired as emeritus professor, but continued for some years to publish, and even, on occasion, to lecture; combining in his "Principles of Christian Art" his two dominant interests. In 1934 a slender volume of "Autobiographica" unveiled much that only intimate friends appreciated or suspected, of his devotion to scientific truth, to the interpretation of beauty in men's handiwork, and to the realization of his own high standard of living.

J. L. M.

Dr. A. H. Church, F.R.S.

Dr. Edith Philip Smith, of the Department of Botany, University College, Dundee, writes as follows:

As an old student of A. H. Church, I should like to add a few words of appreciation and recollection to the obituary notice appearing in Nature of May 22.

No one who has not had the privilege of studying under Church can fully appreciate the manner of man he was. To his students he was an unfailing (but not an uncritical) friend. No slip-shod or incomplete work was tolerated: everything had to be done to a finish, in which he set an example by his unremitting application to his own research. But it was his dispassionate accuracy and integrity of purpose which created the deepest impression.

Church was an inspired teacher. The condensed and often cryptic English of his writings (which has prevented their full appreciation) became clear and enthralling when expanded in lecture or tutorial.

Church's writings have not yet taken the place they deserve in botanical literature, partly on account of their difficult style, and partly because they were all in advance of their time. The "Types of Floral Mechanism", for example, contains the prolegomena to a serious theory of the flower, which has scarcely been assimilated after twenty-nine years. I was told by Church that he had the remaining material of his projected study of the flower completed, but that the expense of publication was prohibitive. I do not know whether any project is on foot for a memorial to Church at Oxford, but I can think of no more appropriate tribute to his memory than to assist in the publication of his floral studies (if they still exist).

We regret to announce the following deaths:

Sir Edward Davson, Bart., K.C.M.G., an authority on Colonial trade and Imperial economics and a trustee of the Imperial Institute, on August 7, aged sixty-two years.

Sir David Masson, K.B.E., F.R.S., emeritus professor of chemistry in the University of Melbourne, aged seventy-nine years.

Prof. F. C. S. Schiller, emeritus professor of philosophy in the University of California, on August 6, aged seventy-three years.

News and Views

Bicentenary of Dr. Charles Hutton, F.R.S.

ON August 14 occurs the bicentenary of the birth of the well-known English mathematician Dr. Charles Hutton, who for thirty-four years held the chair of mathematics at the Royal Military Academy, Woolwich, and who for a long period was a prominent member of the Royal Society. Born in Newcastle-upon-Tyne, Hutton was the son of a colliery labourer and though he attended a dame's school in the Gallowgate, he was almost entirely self-taught. He began life as an assistant teacher at Jesmond, and from 1760 until 1773 he conducted a school of his own in Newcastle and while doing so contributed to the *Ladies' Diary* and other periodicals, and published some excellent elementary works on arithmetic, book-keeping and mensuration. The failure of a bridge in his native city led him to write his "Principles of Bridges and the Mathematical Demonstration of the Laws of Arches", and in 1773 after a severe competitive trial he was appointed to the professorship at Woolwich, where he worked until 1807. In 1774, he was admitted to the fellowship of the Royal Society; in 1775 he made the calculations in connexion with Maskelyne's experiments at Schiehallion, Perthshire, for determining the mean density of the earth, and in 1779 was made LL.D. of the University of Edinburgh and foreign secretary of the Royal Society. This position he held until 1783, when complaints having been made of the way he had carried out his duties, he resigned. Sir Joseph Banks was then president, and Hutton's resignation raised a storm of protest at the way he had been treated. At a meeting of the Society on December 18, 1783, however, when Hutton submitted his "Defence", a resolution was passed stating "that if Dr. Hutton hath been in the opinion of any Member of the Society incriminated, it is the opinion of the Society that he hath fully justified himself".

HUTTON already in 1778 had been awarded the Copley Medal for his paper on "The Force of Fine Gunpowder, and the Initial Velocity of Cannon Balls", and for many years he continued to add to mathematical literature. In 1785 he published his "Mathematical Tables" and this was followed by his "Tracts on Mathematical and Philosophical Subjects", his "Compendious Measurer" and his "Elements of Conic Sections". In 1795 he published his "Mathematical and Philosophical Dictionary" which was described by the "Encyclopaedia Britannica" as the most valuable contribution to scientific biography that had yet appeared in England. In 1803, with the naturalist Dr. George Shaw (1757–1813), and the physician and chemist Dr. George Pearson (1751–1828), he began the abridgement of the *Philosophical Transactions*, an arduous task which occupied him for six years and for which he received £6,000. Retiring from his post at Woolwich in 1807 on a pension of £500 per annum, he took up his residence in Bedford Row, London. Recognized as a most skilful teacher and a man of amiable character, he died on January 27, 1823, in his eighty-sixth year and was buried in the family vault at Charlton, Kent. His "Life" was written by his successor at Woolwich, Dr. Olinthus Gregory.

Digestive Troubles among Omnibus Workers

THE belief that gastric disorders are unduly common among busmen is widespread among the men themselves and their leaders. The problem was placed before the Industrial Health Research Board, and considered by a joint Committee of the London Passenger Transport Board and the Trade Union of Transport and General Workers, and it was the unanimous opinion that an answer should be sought to the following question: Do omnibus workers suffer from digestive complaints more frequently or more severely (or both) than other groups of workers of similar economic and social position? The Committee of the Industrial Health Research Board considered that the investigation of the problem had in the first place to be statistical, and it was decided to make a comparison of the incidence of sickness (limited to periods of more than two weeks' duration) among omnibus workers and tramway workers. The investigation was undertaken by Dr. Bradford Hill, and the results of his inquiry are now published (Report No. 79. Medical Research Council Industrial Health Research Board. H.M. Stationery Office. Price 6*d.* net). An examination was made of the sickness records of omnibus and tramway workers in the employ of the London Passenger Transport Board. The data were extracted for the years 1925–26 and 1933–35, but the records of the first period were found to be unsatisfactory and the analysis of the sickness experience was therefore confined to the data relating to the years 1933–35. The age distributions of the omnibus and tramway workers differ considerably, and it was necessary to compare the occupational groups age by age, and in reaching a comparative figure for all ages to allow for the differences in the age distributions.

IT is found that the omnibus drivers at all ages had in 1933–35 a relative excess of gastric sickness (that is, in proportion to sickness from all causes) of 12–14 per cent over the figure shown by the tramway drivers. In the same way, it is found that the omnibus conductors at all ages had a relative excess of gastric sickness of 15–18 per cent over the figure shown by tramway conductors. But this relative excess varies very considerably with age, for omnibus drivers being confined to the age-group 30–49, and for omnibus conductors to the age-group 20–39, and the higher figures at these ages must be balanced by the lower figures at other ages. When this correction has been made, taking only sicknesses of more than two weeks' duration and a wide group of diseases as attributable to gastric causes, it is found that there was in 1933–35 some excess of gastric illnesses recorded among omnibus workers as compared with tramway workers at those age-groups to which the majority of the former belongs, though at these ages the total sickness experience, from all causes, of the omnibus workers was rather more favourable than that of the tramway workers.

Japanese Trawlers in Indian Waters

A LEADING article in *Current Science* of May directs attention to the rapidly increasing activity of Japanese trawlers in the Bay of Bengal. On more than one occasion the Government of India has been warned that unless adequate steps were taken to improve and develop Indian fisheries in Indian waters, some other country would sooner or later step in and exploit this area for its own benefit; but with the exceptions of the Government of Madras and, more recently, of Bombay, little or nothing has been done by either the Central or Provincial Governments. For some years past the average catches made by Japanese trawlers operating in the Pacific have been steadily decreasing, partly owing to increased competition but also in the main, no doubt, owing to over-fishing, and in consequence they are now seeking for more profitable areas in other waters. So long ago as 1908–9, the *Golden Crown* carried out a series of experimental trawls for the Government of Bengal, and these showed that there were a number of excellent trawling grounds in this area. The average catch obtained compared very favourably with those taken in European waters. The experiment was a failure from the financial side mainly because of difficulties in the distribution and marketing of the catches.

Indian Coastal Fisheries and their Exploitation

IF the Japanese now working in the Bay of Bengal can overcome the marketing difficulties, there seems to be no doubt that they will very materially increase the supply of fresh fish in those ports to which they bring their catches, and in this respect will benefit the inhabitants; at the same time, it must be remembered that this is but one side of the fishing industry and that much material is obtained in the trawl that can be turned, by suitable treatment, to other uses, such as the preparation of dried and salted fish and the manufacture of fish-oil, fish-meal and even fish-manure. In the past, the bulk of the fish guano that is prepared in the Province of Madras is exported, through Ceylon, to other countries and particularly to Japan; the value of this export rose, under the fostering care of the Madras Fishery Department, from 188 tons, valued at Rs. 13,648, in 1910–11, to 32,000 tons, valued at Rs. 24,40,000 in 1922–23, and in 1927–28 it had risen even further to 100,000 tons. If the Japanese trawling in the Bay of Bengal proves to be a success, it is highly probable that in the very near future there will be a marked falling off in the sales to Japan of these Indian fishery products, to the great detriment of the Madras fishermen.

THE present Japanese invasion of Indian waters appears to have commenced in 1935; but its origin can probably be traced back to several years earlier. In 1929–30 the Japanese commenced a surreptitious exploitation of the *Trochus*-shell beds of the Andaman and Nicobar Islands by divers working from motor-boats that were based on Singapore, and this increased to such an extent that the Government of India appointed a fishery research officer in 1931. Unfortunately, owing to lack of proper supervision, undersized shells were fished and, in the absence of any patrolling vessel, grounds that were supposed to be closed were poached, while considerable poaching on the authorized grounds was carried out by unlicensed vessels: in consequence, the shell-beds were rapidly decimated and will take many years to recover. Some of these motor-boats brought with them their fishing nets, and an experiment carried out off Port Blair showed that these nets could be used in these waters with very considerable success, one boat after an absence of two days returning with a catch of about 1½ tons of fish. The natural resources of the ocean are everywhere open to all nations outside the three-mile territorial limit, but unless adequate patrolling of these Indian coastal waters by fishery-protection vessels is carried out—and in view of the great length of coast-line involved this would seem to be impossible—Japanese trawlers will certainly exploit the inshore waters, should experience prove that they are profitable trawling-grounds. A comparison of the various species of fish brought to market by the local fishermen of Akyab in Burma and Puri in Orissa, on opposite sides of the Bay of Bengal, with those taken by the *Golden Crown*, reveals that a large percentage are identical. These local inshore fishing-grounds extend out from the coast for distances varying from about five miles up to as much as 10–15 miles; thus, even were the territorial limit of three miles strictly enforced for these trawlers, there can be little doubt that such trawling by Japanese vessels will affect adversely, and perhaps seriously, the Indian coastal fishing industry.

National Institute of Sciences of India

PROF. M. N. SAHA informs us that the Government of India has decided to make a grant-in-aid of Rs. 6,000 per annum to the National Institute of Sciences of India, Calcutta, with effect from 1937–38. The grant will be subject to the following conditions: (1) Provision should be made for a nominee of the Government of India on the Council of the Institute. (2) An annual report of the working of the Institute, together with a duly audited statement of accounts, should be furnished regularly to the Government of India. (3) The Institute should tender advice on any scientific problems which may be referred to it by the Government of India and discharge any other functions which may be assigned to it by the Government of India. No provision exists in the current year's budget of the Central Government for this grant. It is proposed, however, to include a sum of Rs. 12,000 in the budget estimates for 1938–39 on account of the grant for the year 1937–38 and 1938–39 and, subject to the vote of the Legislative Assembly, steps will be taken to pay this amount early in the year 1938–39.

Devices for Fighting Fires

IN the High Tension Conference held in Paris in June interesting discussions took place as to the relative merits of fire-fighting equipment. In Part 2 of an article by T. Rich in the *Electrician* of July 16, the latest opinions of French engineers on the devices used in practice are given. For protecting transformers and alternators of large output, alarm indicators are used as well as extinguishing appliances. They are of the fixed type which operate automatically when the station has no attendants and when the generators are very large. The movable apparatus generally used consists of extinguishers, boxes of sand, blankets and water jets directly connected to the mains or to a foam generator. Gas masks, smoke fans and emergency lamps are auxiliary apparatus. Portable extinguishers are only used for very small fires. It is important that the material used should be a bad conductor of electricity, as small fires make a close approach necessary and the jet may give a dangerous shock. Carbon tetrachloride has high extinguishing powers and it is not a good conductor. But at high temperatures it decomposes into a gas that is corrosive and poisonous, so that a gas mask is desirable although it entails a loss of time. Methyl bromide is generally thought to give out less poisonous fumes but it is expensive. Saline solutions with a base of potash have a high extinguishing capacity but they are dangerous to use as the jet is a conductor. Carbonic acid snow is not such a good extinguisher but its use entails no danger to personnel. It can be used without cutting off the current, and so is useful in the case of small fires, but the risk of re-ignition is serious. Fire-resisting blankets are used to put out burning clothes on persons. They should be kept in metallic cases with anti-moth material and a window should be put in the case to ensure that the contents have not been borrowed for other purposes. 'Atomized' jets which work under a high pressure have been found useful both in putting out oil fires and cable fires. For hoses rubber is better than woven material. Each 'fire' point at an electric station should have a sand box with wood shovels, a gas mask and a lantern.

Annual Report of the Ministry of Health

THE eighteenth annual report of the Ministry of Health, 1936–37, has been recently issued (H.M. Stationery Office. 5*s*. net). It consists of an introduction and seven chapters, and includes the work of the Welsh Board of Health. The death-rate was 9·2 per thousand, the death-rate of infants below one year 59, and the maternal mortality rate 3·81, per 1,000 live births. Tuberculosis mortality was the lowest on record, being a rate per million living of 583 for pulmonary, and of 109 for non-pulmonary, tuberculosis. Notifications of diphtheria were 7,290 less than for 1935, but still considerably in excess of those for 1933. Of enteric fever, 2,493 cases were notified, compared with 1,750 in 1935, the increase being mainly due to the epidemic last summer at Bournemouth, Poole and Christchurch. Public analysts examined 146,438 samples of food and drugs —a record number—of which 7,802 were reported against. Of this total, 80,082 were samples of milk and 7,588 those of butter. Under slum clearance and rehousing, up to the end of last year 100,355 houses had been demolished and 127,553 houses built to replace them, this being the fourth year of the five years' plan. This year, general progress in town and country planning, especially in preserving the countryside, has markedly increased. No less a sum than £65,000,000 of Exchequer money was spent in 1936 on services administered by the Ministry, but only £2,200,000 of this was expended on central administration.

Apparatus for Testing Petroleum and Related Products

A CATALOGUE of scientific apparatus is necessarily a classified list of separate items and to repay reading must be clearly printed, attractively set out, adequately illustrated and up to date. Messrs. Gallenkamp and Co.'s catalogue (No. 96A, 1937 Edition) listing apparatus for testing petroleum, tar, asphalt and their products, fulfils all these requirements and will be of definite interest to those engaged in the examination of these substances. The listed apparatus includes types standardized for routine tests by the Institution of Petroleum Technologists, the Standardization of Tar Products Test Committee, the British Standards Institution and the American Society for Testing Materials, as well as many other special forms which for one reason or another have not been so standardized. The drawings, in general, have been executed with due attention to detail, although on p. 35, an unsuitable type of ring burner has been included in the diagram of the apparatus for the determination of water in asphaltic substances; on p. 43, the position of the thermometer in the R and B softening point apparatus is incorrect and on the same page, the K and S softening point apparatus depicted is not the standard type specified by the S.T.P.T.C. The arrangement of the subdivisions is at present somewhat haphazard, necessitating frequent reference to the index; it could be improved by the substitution of an alphabetic order on the lines of the Institution of Petroleum Technologists' hand-book. Despite these defects, the catalogue will be appreciated by technologists specializing in the fields indicated in the title.

Natural Colour Eclipse Photography

WE have received from Mr. Edward R. Hewitt, of 127 East 21st Street, New York, a correction of the statement, quoted in NATURE of March 13, that the *National Geographic Magazine* of February contained the first natural colour photograph of a total solar eclipse ever reproduced. Mr. Hewitt informs us that the *Scientific American* of April 1925 reproduced a colour photograph, made by him, of the total eclipse of January 24, 1925, and has sent us a copy of the reproduction. Mr. Hewitt, in 1925, used Autochrome plates specially sensitized by himself, and his camera had a focal length of 3 ft. Dr. Gardner, in 1936, used Dufay colour plates and a camera of 19-ft. focal length. Owing to the greatly differing circumstances, any detailed comparison of the two pictures would be invidious. The picture Mr. Hewitt has sent us is about a tenfold enlargement of the original, and shows a yellow coronal image extending to about a fifth of a solar radius from the limb, so that on the original plate the coronal image can only have been about 0·6 mm. across, whereas Dr. Gardner's picture was reproduced at about actual size and showed a corona extending to about a solar radius or about 20 mm. on the original plate. In view of the low resolving power of colour plates, it would be absurd to expect much recognizable detail on the 1925 plates, and indeed there is only a suggestion of coronal form, and the colour is presumably in error, but the photographs had the value of demonstrating that colour plates could be made sensitive enough to photograph a total eclipse.

Plant Diseases and Pests of India

Science and Culture contains an interesting review of "Some Plant Diseases and Pests of India and their Control" by Amil Mitra (2, Nos. 8 and 9, Feb. and March 1937). The paper should serve the useful purpose of directing attention to the serious nature of plant disease, for it includes succinct references to the monetary or percentage losses occasioned by many fungi and insect pests. These are sufficiently convincing. The world's loss through the activities of various rust diseases of wheat is estimated at about £60,000,000, and India bears about £4,000,000 of this. A smut disease of the Jowar crop, caused by the fungus *Sphacelotheca sorghi*, causes a loss of 20–25 per cent, and in the Bombay Presidency alone, this means a cost of two crores of rupees (about £2,000,000). Sugar cane mosaic, caused by a virus, often lowers the yield of sugar by 30–35 per cent, whilst a wilt of the pea crop caused by the fungus *Fusarium Vasinfectum* seems to cause the highest percentage damage, for more than half the crop is often lost as a result of its depredations. The review mentions the particular methods of control for each disease or pest, which have been found most effective in practice. A few insect and eelworm enemies are mentioned, but the main emphasis of the paper is that of a mycologist.

Journal of Parapsychology

An introduction by Prof. Wm. McDougall gives reasons for the publication of a new journal, the *Journal of Parapsychology*, and making clear its object. Throughout the ages, people have asked: Are mental processes always and everywhere dependent upon material and physical organizations? What are the relations of mind and matter? Do the volitions and beliefs of men make any difference to the historical course of the events of the world? Is the physical co-extensive with the mental and the powers and potentialities of mind to be defined by the laws of the physical sciences? For the most part, the psychology studied in the universities has not concerned itself experimentally with these problems, and such work as has been undertaken has generally been the leisure-time pursuit of interested amateurs. Prof. McDougall thinks that all those phenomena vaguely denoted by the phrase, 'psychical research', ought to be the study of trained scientific workers in the universities, both in the interests of the development of knowledge and of the public. A beginning was made at Duke University in 1930 to study what the researchers called 'extra-sensory' perception. In order that the experiments made in one laboratory may be repeated by other workers, it seemed desirable that there should be a journal. The need for multiple repetitions by different observers of all experiments purporting to give positive results is greater in this field than in others. The word parapsychology is chosen to denote the more strictly experimental part of psychical research. The journal is published quarterly, and the first number is dated March 1937 (Durham, N.C.: Duke University Press. Subscription 3 dollars a year).

Cist Burial at Blaydon-on-Tyne

An interesting example of a cist burial is reported from Blaydon-on-Tyne (*The Times*, Aug. 6). The discovery was made by workmen digging in a sand-pit, who uncovered the broken upper slab of the chamber. The dimensions of the cist were 3 ft. 8 in. in length, 2 ft. 3 in. wide and about two feet in depth. The interior was filled with sand, but among the contents were found a human skull and bones of the skeleton. With them was a flint knife about two inches in length. The site was visited and the cist examined by Miss G. M. Scott, assistant curator of the Hancock Museum, Newcastle, Mr. W. Bulmer, of the Corbridge Museum, and other authorities of the locality, in whose opinion the find belongs to the Bronze Age and is to be assigned, notwithstanding the absence of the beaker which might be expected, to a date at about 1500 B.C. A burial with skeletal remains of a somewhat earlier date was found on Summerhill, not far away, seven years ago and is on view as reconstructed in the Hancock Museum.

National Museums of Natural History

Frequent visits from, and even interchange of, the staffs of the larger museums of the British commonwealth of nations, as referred to in an article in Nature of January 9, has evidently the strong approval of Mr. Frederick Chapman, the well-known authority on the Foraminifera, who has written to us from Melbourne on the subject. The 'Australian Museum' is situated at Sydney and there is the 'Melbourne National Museum', which from the wealth of its collections, especially palæontological, must be regarded as also of the highest rank. It is immaterial that one museum may be richer than the other in some sides of biology, for such must always be the case. The important matter is that tightening of the bonds between all the museums in question, which has the approval of the Museum Association of Australia. Further, we understand that a representative of this Association was deputed to discuss this with the trustees of the British Museum this summer. When can we expect to hear the result of this discussion ?

Research at Armstrong College

From Armstrong College, Newcastle-upon-Tyne, we have received a report for 1935–36, somewhat belated, by the Standing Committee for Research. The importance of some of the work accomplished with the help of the Committee's small subventions (twenty-six grants amounting in the aggregate to £846) is well brought out in an eighteen-page summary prefixed to the individual reports of the recipients and list of publications. An obvious advantage of a fund such as that administered by the Committee, unappropriated in advance to specified fields, is that its administration compels representatives of different departments to take an interest in research in each other's fields, and this promotes inter-departmental collaboration in research, instances of which are cited in the report. Of the role of philosophy in the University, the Committee takes a liberal view, for it refers to works emanating from the College's Department of Philosophy as "original contributions towards the formation of that background of knowledge which forms, or should form, the background of university education".

American Documentation Institute

The American Documentation Institute was incorporated at a meeting in Washington on March 13 as a corporation "not for profit" but for educational, literary and scientific purposes. The first objective of the new organization is to develop and apply the new technique of microphotography to library, scientific and other material. This national organization was foreseen as an outline of the documentation activities of Science Service when they commenced in July 1935. Bibliofilm Service has been conducted by Science Service in co-operation with the Library of the U.S. Department of Agriculture as a service to research workers, and in auxiliary publication through microfilm, leading academic and scientific journals have co-operated.

Cytological Technique

A short but useful pamphlet giving an "Outline of Cytological Technique for Plant Breeders" is issued by the Imperial Bureau of Plant Genetics (1*s.* 6*d.*). Genetics and cytology have become so intimately interwoven in their results that every plant breeder needs to have some knowledge not only of chromosome investigations but also of the methods of cytology. The various techniques involved are sufficiently exacting if satisfactory results are to be obtained. This pamphlet gives an account of the paraffin method, the smear method and a short statement containing the essentials of technique in the use of the microscope, the methods being based mainly on the schedules in use at the John Innes Horticultural Institution, Merton.

Microscopy: the Quekett Microscopical Club

Watson's *Microscope Record* of May (No. 41), among other matter, contains an account by Mr. J. F. Stirling of the microscope used by John Dalton, now in the possession of the Manchester Literary and Philosophical Society, and an article by the editor on the appropriate eyepiece to use with certain objectives. Two new species of Bdelloid Rotatoria are described by Mr. W. E. Garner in the *Journal of the Quekett Microscopical Club* of April (Ser. 3, 1, No. 7, p. 280). Mr. W. E. Watson Baker is the new president of the Quekett Club, which is holding its annual conversazione on October 12 in the rooms of the Royal Society at Burlington House.

Conference on Protection against Natural Disasters

The first "Conférence internationale pour la protection contre les calamités naturelles" is to be held at the Paris Exhibition on September 13–17. The following titles of sections of the Conference indicate its scope : vulcanology and seismology, meteorology, zoology and epidemiology, economic and social crises (fires, famines), assurances. The organizers of the Conference are the Commission Française d'études des calamités, one of a dozen such national commissions which owe their existence to the initiative of the editorial board of the scientific periodical, *Matériaux pour l'étude des calamités*, established in 1924 by M. Raoul Montandon. In that year the Italian commission was formed. Its president is Giovanni Ciraolo, who is also president of the Union internationale de secours founded by the League of Nations in 1927, when the French commission was formed. Later, similar bodies were established in Austria, Belgium, Bulgaria, Chile, Czechoslovakia, Greece, Hungary, Italy and Switzerland. Others are in course of formation in Russia and Yugoslavia. The opening session will be presided over by the Under-Secretary of State for Scientific Researches and the closing session (to be followed by a reception at the Hôtel de Ville and a banquet) by the Minister for the Colonies. Admission to membership of the Conference involves payment of a fee of 100 francs, exclusive of the charge of 40 francs for participation in the banquet. Membership will carry the right of free entry to the Exhibition during the Conference. The address of the secretariat is : Laboratory of Applied Entomology, 45 bis, rue de Buffon, Paris, 5^e. The secretariat will, if desired, reserve bedrooms for members.

Comet Finsler

Prediction for the place of Finsler's Comet for the next three weeks is given in Announcement Card No. 421 issued by Harvard College Observatory. The ephemeris is based on a parabolic orbit computed by Dr. A. D. Maxwell of the University of Michigan. The time of deduced perihelion passage is August 15·76946 U.T. This comet was discovered on July 4 last by Finsler at Zurich ; it was then of the 7th magnitude. It is now possible to locate the comet with the naked eye. The following predicted positions at 0^h U.T. show that the comet will pass 3° or 4°

west of the bright star, Arcturus, between August 22 and 23. In the latitude of London, Arcturus sets in the north-west about an hour after midnight (Summer Time) in the middle of the month.

Date	R.A.	Dec.	Date	R.A.	Dec.
Aug. 14	13h. 30·6m.	+ 45° 04′	Aug. 26	14h. 02·5m.	+ 13° 10′
„ 16	13 40·6	+ 37 54	„ 28	14 04·4	+ 10 11
„ 18	13 47·8	+ 31 31	„ 30	14 05·9	+ 7 26
„ 20	13 53·1	+ 25 57	Sept. 1	14 07·2	+ 5 02
„ 22	13 57·0	+ 21 07	„ 3	14 08·2	+ 2 54
„ 24	14 00·1	+ 16 56			

Announcements

THE following research fellowships in tropical medicine have recently been awarded by the Medical Research Council: *Senior fellowship* to Dr. Frank Hawking, assistant lecturer in pharmacology, Welsh National School of Medicine, Cardiff; this is tenable for three years, for investigations to be made mainly in the tropics. Dr. Hawking will work in Africa on the chemotherapeutic treatment of sleeping sickness. *Junior fellowships:* D. A. Cannon; J. L. Dales, assistant pathologist, Royal Hospital, Sheffield; I. W. MacKichan, house surgeon, London Hospital.

ON the recommendation of the Agricultural Research Council the following awards of agricultural research scholarships, studentships for research in animal health and veterinary scholarships have been made by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland: P. J. Faulks (plant physiology), R. S. Russell (plant physiology), F. H. Malpress (nutritional chemistry), J. Wilson (plant genetics), G. H. L. Dicker (entomology), J. W. Whittick (animal pathology), F. D. Asplin (poultry diseases), Miss K. M. Massey (poultry diseases).

THE following awards for 1937–38 have recently been made by the Salters' Institute for Industrial Chemistry and approved by the Court of the Salters' Company: a fellowship has been renewed to L. M. Baxt, Imperial College; fellowships have been awarded to R. H. Freak, University of Oxford, A. J. Shorter, University of Birmingham, J. L. Tuck, University of Manchester, and S. H. Wade, Imperial College of Science and Technology; the Salters' Institute has also awarded forty grants-in-aid to young men employed in chemical works in or near London to assist them in their studies.

DR. J. ANDERSON has been appointed representative of the Scottish Beekeepers' Association on the Bee Research Committee that advises it in regard to investigations on bees carried out at Rothamsted. Dr. Anderson is well known for his special knowledge of bee problems and for his admirable work in Scotland in applying science to the solution of the beekeepers' difficulties.

EIGHT honorary memberships of the Engineering Institute of Canada were conferred at the semi-centennial meeting of the Society held in Montreal recently. The engineers honoured include Sir Alexander Gibb, president of the Institution of Civil Engineers; the Hon. C. D. Howe, Minister of Transport, Ottawa; the Hon. Grote Stirling, former Minister of National Defence, Kelowna; Prof. R. W. Angus, professor of mechanical engineering at the University of Toronto; Dr. George Herrick Duggan, a past-president of the Engineering Institute of Canada and chairman of the Dominion Bridge Company, Montreal; and Mr. S. J. Hungerford, chairman and president of the Canadian National Railways, Montreal.

DR. JOHN K. SMALL, chief research curator of the New York Botanical Garden, who has described the proposed Everglades National Park on p. 263 of this issue, has sent us sixty papers, of diverse botanical interest, published in the *Journal of the New York Botanical Garden*, and extending over a period of twenty years. The papers demonstrate great field activity on the part of the author, especially in plant morphology and ecology. It is interesting to note that Dr. Small has published about a hundred reports on explorations and fourteen descriptive floras concerned chiefly with the south-eastern United States. Copies of these publications can be obtained from the Science Press Printing Co., Lime and Green Streets, Lancaster, Pasadena.

DR. ADOLF BUTENANDT, director of the Kaiser Wilhelm Institute for Biochemistry, has been awarded the Scheele Medal of the Chemical Society of Stockholm.

GEHEIMRAT PROF. CARL BOSCH has been elected president of the Kaiser Wilhelm Society for the Advancement of Science in succession to Prof. Max Planck.

THE Gluge Prize of physiology of the Belgian Royal Academy of Sciences has been awarded to Prof. J. J. Bouckaert of the University of Ghent.

DR. VICTOR G. HEISER has been awarded the Medal for Distinguished Service of the Pennsylvanian Society of New York in recognition of his medical research work under the auspices of the Rockefeller Foundation.

THE sixteenth American Congress of Physical Therapy will be held in Cincinnati, Ohio, on September 20–24 at the Netherlands Plaza Hotel, under the presidency of Dr. William Bierman of New York. Further information can be obtained from the editorial and executive offices of the Congress, 30 North Michigan Avenue, Chicago.

AN International Congress of the Scientific Press organized by the Professional Syndicate of the Scientific Press will be held in Paris on October 7–9. Further information can be obtained from M. Toutain, 25 rue du Four, Paris.

ERRATUM. In NATURE of August 7, p. 229, the date of the erection of the Roman bath at Leicester should be, obviously, A.D. and not B.C. as stated.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 283.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Lecithinæmia following the Administration of Fat

ABOUT two hours after the administration of a meal containing fat, the fat content of the blood begins to rise. Bloor[1] found that when olive oil is administered to a dog, besides an increase in the neutral fat content of the blood an increase in its lecithin content also takes place. The average increase was found to be about 20 per cent. A maximum is reached after four hours. Bloor was inclined to ascribe the lecithin formed after the administration and resorption of the neutral fat to a synthesis occurring inside the red blood corpuscles. Other explanations might, however, be suggested as well, namely: (1) The lecithin is synthesized in the intestinal mucose and resorbed into the blood. (2) The synthesis takes place, after the resorption of neutral fat, in the liver, or somewhere else outside the intestinal tract. (3) The increase in the lecithin content of the blood is due to mobilization of preformed lecithin after the resorption of the neutral fat.

To decide which of these suggestions is to be accepted we repeated Bloor's experiment, but administered simultaneously with the oil labelled (radioactive) phosphorus in the form of sodium phosphate. In the case denoted by (1) the additional blood lecithin should contain chiefly labelled phosphorus; in case (2) the additional lecithin should contain only small amounts of labelled phosphorus; in case (3) the additional lecithin should contain ordinary phosphorus only.

We determined the normal P present in the blood lecithin, which was extracted by the usual procedure, by the method of Fiske and Subbarow, and the labelled P by means of a Geiger counter. While, as seen in the table, the lecithin phosphorus content of 100 c.c. of blood increased by 2 mgm. four hours after administering the oil, that of labelled P only increased by 0·096 mgm. We must, furthermore, take into account the fact that half the labelled phosphorus administered two hours before the oil produced 0·028 mgm. labelled lecithin P during that time. We must therefore deduct 2 × 0·028 mgm. from the 'oil effect' of 0·096 mgm., obtaining 0·04 mgm. per 100 c.c. of blood for the maximum value of the 'oil effect'.

An important objection can, however, be raised to our conclusion; it may be argued that the intestinal tract might contain large amounts of phosphorus other than the labelled phosphate administered by us, the presence of which must be accounted for when carrying out the above calculation. To investigate this point and to ascertain to what extent the labelled phosphorus was resorbed, we killed the dog after the last experiment, the results of which are seen in the table. We washed the intestinal tract with water and determined both its total P content and its labelled P content. We found by activity measurements 39·6 mgm. labelled P and by chemical determination 175 mgm. normal P. Within six hours as much as 260·4 mgm. of the 300 mgm. administered to the dog was thus resorbed. The 135 mgm. non-labelled phosphorus got into the intestine, presumably along with the digestive fluids, so that the 40 mgm. labelled P were 'diluted' to 175 mgm. We determined also the total acid-soluble phosphorus content of the intestinal mucose; it was found to amount to about 40 mgm., bringing the above figures up to 215 mgm. But even if we make the assumption that this dilution was present during the whole of the resorption process we should get the result 5·2 × 0·064 = 0·21 mgm. per cent lecithin P, while an increase of 2 mgm. per cent was found in the blood lecithin P.

Time in hours	Labelled P given in mgm.	Lecithin phosphorus found in 100 c.c. blood		Labelled total P found	
		Total	Labelled	in 100 c.c. blood	in the total blood of the dog
0	150	—	—	—	—
2	150 (+ 50 gm. oil)	16·0 mgm.	0·028 mgm.	1·03 mgm.	6·18 mgm.
4	—	15·5 „	0·048 „	2·03 „	12·18 „
6	— (250·4 mgm. *resorbed*)	18·0 „	0·096 „	2·00 „	12·00 „

It is of interest to compare the labelled P content resorbed with that actually found in the blood stream of the dog. Six hours after the beginning of the experiment, as is seen in the table, only 4·6 per cent of the amount resorbed was found. This result illustrates beautifully the great rapidity of the phosphorus exchange in the body. As observed by us in numerous cases, the individual phosphorus atoms present in the blood stream exchange their places rapidly with others present in the different organs. For this reason we can conclude with certainty that during our experiments the ratio labelled phosphorus to ordinary phosphorus must have been appreciably higher in the intestinal mucose than in the blood.

The only moderate increase in labelled phosphorus in the blood lecithin after administration of oil, an increase which nevertheless in all our experiments exceeds the increase observed after the radioactive phosphorus was administered alone, leads to the conclusion that during the absorption of neutral fat, lecithin is formed outside the intestinal tract. A comparatively rapid formation of labelled lecithin in several organs in the course of normal metabolism has in fact recently been observed[2].

Some of the labelled phosphorus used in our experiments was prepared by us from sulphur under the action of neutrons emitted by a radium-beryllium mixture most kindly put to our disposal by Prof. Niels Bohr, and some of it was a generous gift from Prof. Lawrence, of the University of California. We should also like to express our best thanks to Mr. A. H. W. Aten, jun., and Miss Hilde Levi for their assistance in this work.

G. HEVESY.
E. LUNDSGAARD.

Institute for Theoretical Physics
and
Institute for Medical Physiology,
University of Copenhagen.

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[1] Bloor, W. R., *J. Biol. Chem.*, **23**, 317 (1915); **24**, 446 (1916).

[2] Artom, C., Sarzana, G., Santagelo, M., and Segré, E., NATURE, **139**, 836 (1937). Comp. also Hahn, L., and Hevesy, G., *Scand. Archiv. f. Phys.*, Aug. 1937).

A New Source of Vitamin A

IN the course of a study of the mode of occurrence and distribution of vitamin A, we have found that the viscera (excluding the livers) of halibut yield abnormally rich oils (see table).

VITAMIN A IN HALIBUT

Weight of fish (kgm.)	Weight of liver (kgm.)	Weight of 'viscera'* (kgm.)	Weight of liver oil (gm.)	Weight of 'visceral' oil (gm.)	Weight of vitamin A		Percentage† vitamin A	
					in liver (gm.)	in viscera (gm.)	in liver oil	in visceral oil
45·4	1·03	1·67	203	36	3·84	2·88	*c.* 2·0	8·0
45·4	0·54	1·47	70	27	1·53	1·51	2·2	5·6
28·6	0·40	0·76	34	15	2·1	1·05	6·3	7·0
23·6	0·34	0·85	—	15	—	0·9	*c.* 4·6	6·0
26·9	0·51	1·04	—	17	—	0·48	0·33	2·8
36·3	0·91	1·06	205	20	0·22	0·32	0·11	1·6

* In this table the term 'viscera' refers only to stomach, mesentery and intestines.

† Percentage is calculated on the basis for vitamin A, so that for an 8 per cent oil we have:—

$$E^{1\%}_{1\text{cm.}}\begin{array}{ll} 620\ \text{m}\mu & 5{,}000 \\ 583\ \text{m}\mu & 2{,}600 \\ 328\ \text{m}\mu & 1{,}600 \end{array}$$

$$E^{1\%}_{1\text{cm.}}\begin{array}{ll} 620\ \text{m}\mu & 400 \\ 583\ \text{m}\mu & 208 \\ 328\ \text{m}\mu & 128 \end{array}$$

The fish were caught in Shetland waters in May this year and their stomachs were free from food. The viscera are normally thrown into the sea although they may contain, as in these cases, as much vitamin as the liver, and may yield more potent oils.

In the eye, Wald has shown that vitamin A forms a complex with protein. In order to test whether a similar complex occurs in liver, we have attempted to extract liver oils without denaturing proteins. In a number of instances the oil obtained by the use of non-polar solvents contains much less vitamin A than the oil obtained in other ways from the same liver. The phenomenon is best shown with livers poor in vitamin, but even in halibut, part at least of the vitamin A is not present in oil solution.

This work is being carried out under the auspices of the Medical Research Council and the Food Investigation Board.

J. A. LOVERN.

Torry Research Station,
Aberdeen.

J. R. EDISBURY.
R. A. MORTON.

University of Liverpool.
July 6.

Intensity Ratios of the Hyperfine Structure Components of the Resonance Lines of Potassium

IN view of conflicting evidence as to the sign of the nuclear spin of potassium 39, it was decided to make a quantitative investigation of the intensities of the hyperfine structure components of the resonance lines. The method used was similar to that used by the authors for the hyperfine structure of the resonance lines of silver[1]. The absorption produced by an atomic beam of potassium in the resonance lines given by a potassium lamp similar to that previously described was observed by means of an etalon of 5 cm. plate separation, with heavily silvered plates. Under these conditions, the adjacent orders of the emitted lines are well separated from each other, and the hyperfine structure can be observed as a narrow absorption doublet. In order to measure intensities, a photograph is made first of the emitted light without absorption, and then with absorption; the reductions in the logarithmic intensities by the absorption lines give their respective absorption coefficients, and the ratio of these the required intensity ratio.

The collimation of the atomic beam was 1 : 8; the absorption of the hyperfine structure was observed best when the temperature of the potassium was about 150° C. (v.p. = 5×10^{-4} mm. mercury), the absorption in the weaker component of the line $4S_{1/2} - 4^2P_{3/2}$ being about 50 per cent. Seven determinations of the intensity ratio were made for this line; the values were 1·44, 1·44, 1·44, 1·38, 1·43, 1·48 and 1·45, the mean being 1·44; the component of longer wave-length being the stronger. For the line $4S_{1/2} - 4^2P_{1/2}$, four determinations of the intensity ratio were made, the values being 1·52, 1·42, 1·40 and 1·45, mean 1·45; the component of longer wave-length was the stronger. A photometer trace of this line is shown in Fig. 1, three orders being shown.

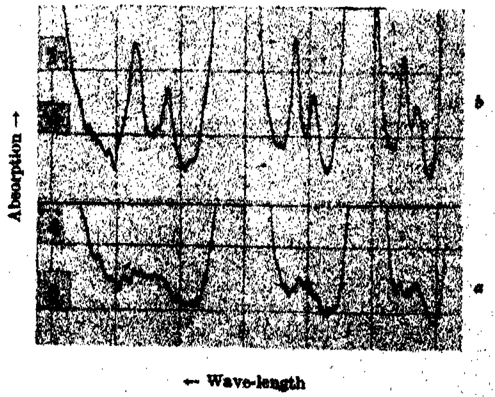

Fig. 1.

a, LIGHT SOURCE ONLY; *b*, ABSORPTION OF ATOMIC BEAM.

It was observed that when the density of the atomic beam was increased twenty times by raising the temperature of the potassium to 200° C.

(v.p. = 7 × 10^{-3} mm.) the short wave-length component in both resonance lines became considerably broadened, its width being about 0·012 cm.$^{-1}$, that of the other component being about 0·008 cm.$^{-1}$.

According to Millman and Fox and Rabi[2] the nuclear moment of K39 is 3/2. The observed intensity ratio is in agreement with this if it is assumed that both the hyperfine structure components of K41 lie on the weaker component of K39; in this case the observed intensity ratio should be $1{\cdot}67/\left(1 + \frac{2{\cdot}67}{14}\right) = 1{\cdot}40$, the total intensity of K41 being 1/14 of that of K39. This is in good agreement with the observed value 1·44. The broadening of the weaker component at very high densities is strong evidence in favour of this interpretation, as the separation of the two high-frequency components of K41 is 0·00853 cm.$^{-1}$ according to Manley[3]. The spreading out by this structure of the absorption of K41 could reduce its influence on the intensity by about one third, the calculated intensity ratio becoming 1·46, and thus in even better agreement with the observed. No trace of absorption due to K41 outside that due to K39 was found with 5 cm. and 2 cm. etalons when the atomic beam was twenty times as dense as that needed to give 50 per cent absorption by K39; and the intensity of the background was varied by giving exposures up to 20 times normal.

On the above view the centre of gravity of the components of K41 overlaps the weaker component of K39; this indicates a violet isotope shift of K41 equal to about 0·009 cm.$^{-1}$; the normal centre of gravity shift is theoretically 0·009 cm.$^{-1}$.

It is thus shown that the spectroscopic determination of the nuclear moment of K39 is in complete agreement with those made by Rabi and others; the sign of the magnetic moment is positive[4], and the value of the spin 3/2.

In a previous note[5], we stated that the short wave-length hyperfine structure component of $4S_{1/2} - 4^2P_{3/2}$ appeared stronger; this discrepancy can be explained; for the photometer traces of the absorption in which this was observed were made from photographs (intended for measurement of distance of high-frequency components and not for intensity measurements) made with an etalon of 10 cm. plate separation; under these conditions the emitted lines in adjacent orders overlap each other, so that in the position where the absorption was observed there is unabsorbable light from the wing of the emitted line in the adjacent order. The density of the atomic beam was very high (temperature of potassium 220° C.) so that the absorption was almost complete, and the light transmitted was due to the overlapping wing, and had no significance as to the intensity ratio of the high-frequency components.

The observation of Fisher[6] that the short-wave components appear stronger in an excited atomic beam can perhaps be explained by self-absorption; moreover, it has been observed by K. W. Meissner[7] that the long wave component is the stronger in an excited atomic beam.

D. A. JACKSON.
H. KUHN.

Clarendon Laboratory,
Oxford. July 16.

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[1] Jackson, D. A., and Kuhn, H., *Proc. Roy. Soc.*, A, 158, 372 (1937).

[2] Millman, S., *Phys. Rev.*, 47, 739 (1935). Fox, M., and Rabi, F., *Phys. Rev.*, 48, 746 (1935).

[3] Manley, J. H., *Phys. Rev.*, 49, 921 (1936).

[4] Torrey, H. G., *Phys. Rev.*, 51, 501 (1937).

[5] Jackson, D. A., and Kuhn, H., NATURE, 137, 108 (1936).

[6] Fisher, R. A., *Phys. Rev.*, 51, 887 (1937).

[7] Private communication from Prof. Meissner.

Expulsion of Neutrons from Lead by Cosmic Rays

A NEUTRON counter was made of a brass tube 10 cm. long and 1 cm. in diameter, the inner surface being coated with a thin film of borate a few microns thick. The axial collector of the ionization chamber was directly connected to a set of the improved linear amplifier system, which was so carefully mounted that the counting system was perfectly free from the mechanical and electrical disturbances of the surroundings, and gave only two to four clear, natural kicks in an hour. By a series of control experiments with neutrons from a radium-beryllium source (of 10 mgm. radium), it was found very reliable for observing slight variations in the number of kicks under various experimental conditions.

Now when the counter was placed inside a lead chamber 50 cm. long and 10 cm. thick (the dimensions are shown in Fig. 1) the number of kicks was found to increase to about 7 per hour, while it amounted to about 15 per hour when the space around the chamber was filled with paraffin.

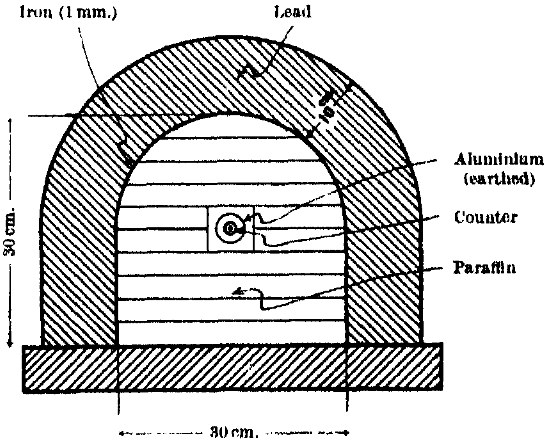

Fig. 1.

These observations were carefully done intermittently for half a year. Though it was difficult to maintain the constant reliability of the counting system for a long duration of time (the results for different dates were sometimes markedly different) most of the results obtained in good conditions were found to lie within the following extreme values:

	Natural kicks outside the chamber	Kicks inside the lead chamber without paraffin	Kicks inside the lead chamber filled with paraffin	Kicks outside the chamber but within paraffin
Min.	2 per hour	4–6	9–12	Less than those counted in the lead chamber without paraffin
Max.	4 ,,	7–9	18–20	

(Boron-surface: 10 cm. in length and 1 cm. in diameter.)

This result shows that a number of fast and slow neutrons are produced by the action of cosmic rays in lead (or less probably in iron or in paraffin).

At first it was suspected that they were liberated at the instant of the production of a 'shower' in lead. But the remarkable Wilson chamber photograph taken by Blackett[1] showing the disintegration of an atomic nucleus into heavy particles by cosmic rays, and the interesting research on the general nuclear photo-effect reported by Bothe and Gentner[2], suggest to us that a neutron or neutrons may be liberated from a lead nucleus by a cosmic ray photon, presumably accompanying a kind of disintegration into heavy particles (general Chadwick and Goldhaber's effect).

A recent report by Fünfer[3] on the existence of slow neutrons in the atmosphere corresponds probably with the existence of the natural kicks in our experiment, which is, however, not sufficiently sensitive to decide the matter.

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June 6.

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[1] "Kernphysik", edited by E. Bretscher, p. 108 (E. J. Williams) (Berlin: Julius Springer, 1936).

[2] Bothe, W., and Gentner, W., *Naturwiss.*, **25**, 90 and 126 (1937).

[3] Fünfer, E., *Naturwiss.*, **25**, 235 (1937).

Electron Diffraction Studies of Oxides formed on Iron

THAT iron oxidized at high temperatures forms a scale composed of three layers, namely, ferrous oxide (below 575° C., does not form), magnetic oxide and ferric oxide is generally known. I have examined oxide films formed on a clean surface of iron exposed to air at various pressures and temperatures, using the electron diffraction reflection method, and have been able to ascertain the condition for the formation of these oxides.

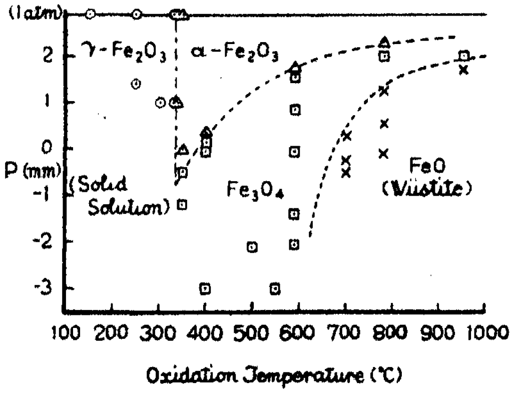

Fig. 1.

The iron specimens, after being etched to remove any polishing effects, were heated to definite temperatures in a highly evacuated tube and then oxidized by introducing air at definite pressures. After an appropriate period of oxidation, the tube was again evacuated as quickly as possible and in the meanwhile cooled in two or three minutes to room temperature. The space lattices of oxides were determined by electron diffraction photographs. The regions where the various oxides are formed are shown in Fig. 1. The duration of exposure has no effect on the resulting oxide except in a few cases.

The facts that lower oxides are formed at higher temperatures under reduced pressures and that prolonged exposure does not elevate the degree of oxidation but is manifested only in the increase of scale thickness are interesting phenomena indeed. These phenomena lead us to the suggestion that iron atoms migrate more vigorously towards the surface with rising temperature and check any further oxidation of the lower oxides.

Only the oxide of the structure of Fe_3O_4 type is obtainable below 340° C., and considering other parts of the diagram this oxide was concluded to be γ-Fe_2O_3. The invisible films[1] of passive iron and of the iron polished in air and the oxide film[2] formed in air below 200° C. were recently concluded to be γ-Fe_2O_3. These two cases are included within the γ-Fe_2O_3 region of the diagram.

In other investigations[3], the transition point between γ-Fe_2O_3 and α-Fe_2O_3 was indistinct; but in this work it was ascertained that the point lies almost at 340° C., and in the immediate vicinity of this temperature both oxides are formed in almost amorphous state. The ordinarily impossible transition from α-Fe_2O_3 to γ-Fe_2O_3 was verified to be possible by maintaining the temperature of this nearly amorphous α-Fe_2O_3 at 330° C.

Specimens heated at 200° C. and 250° C. for a short while produced an extra ring corresponding to 3·4 A., besides the diffused γ-Fe_2O_3 pattern, which disappeared on further heating. It is hoped that better identification may be arrived at for this unknown primary oxide from a different angle.

Experimental details and technique will be reported in the *Scientific Papers* of this Institute.

I wish to express my thanks to Dr. I. Iitaka and Mr. S. Miyake for their kind guidance.

TAKEO IIMORI.

Institute of Physical and Chemical Research,
Tokyo. July 5.

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[2] Miley, H. A., *Iron and Steel Inst., Carnegie Schol. Mem.*, **25**, 209 (1936).

[3] Fricke, R., and Zerrweck, W., *Z. Elektrochem.*, **43**, 54 (1937). Miyake, S., *Sci. Pap. I.P.C.R.*, **31**, 165 (1937).

β-Decay as due to a Neutrino Shower

ACCORDING to the Fermi theory of β-decay, the β-curve representing the number of electrons with a given energy lying in the interval of the transition energy of the nucleus, is governed by a statistical factor which may, however, be deduced in a simple manner as shown by Uhlenbeck and Goudsmit. Experimental curves indicate the existence of a marked asymmetry about half the transition energy of the nucleus, while the statistical factor in the Fermi theory is practically symmetrical.

If we imagine the final process to consist of a shower of neutrinos (the number in the shower depending on the transition energy of the nucleus), with intermediate stages, the asymmetry can receive a simple explanation. Indeed, following the basic transformation pictured by Fermi and assuming the Jordan formulation that a high-energy electron makes a transition to a lower energy state with the emission of two neutrinos the total energy of which is equal to the transition energy of the electron, we can follow the shower production in a way analogous to Heisenberg's theory. The transformations in the β-decay would be

$$N \rightarrow P + e + n, \qquad \text{(Fermi)}$$

$$\left.\begin{array}{l} e \rightarrow e^{\text{i}} + n^{\text{i}} + n^{\text{ii}}, \\ e^{\text{i}} \rightarrow e^{\text{ii}} + n^{\text{iii}} + n^{\text{iv}} \end{array}\right\} \quad \text{(Jordan)}$$

resulting in

$$N \rightarrow P + e^{\text{ii}} + n + n^{\text{i}} + n^{\text{ii}} + n^{\text{iii}} + n^{\text{iv}},$$

where N, P, e and n stand for neutron, proton, electron and neutrino. The electron e^{II} may further undergo a Jordan transformation depending on its energy in the field of the nucleus. The number of electrons with less than half the transition energy of the nucleus would be greater than that of those with energy greater than half the transition energy as there would be the tendency for the higher energy electron to undergo the Jordan transformation, thus resulting in an asymmetrical curve representing the number of electrons with a given energy.

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An Inexpensive Low-Temperature Thermostat

SINCE the low-temperature thermostats on the market involving an electric refrigerator and temperature regulator are very expensive, it is possible that the following easily constructed apparatus (Fig. 1) may prove of value to many research workers. It was designed for the purpose of subjecting small aquatic animals to a constant temperature over a range of 4°–10° C. Our present apparatus will maintain a constant temperature ± 0·1° C. Working at 5° C. it will consume approximately ½ cwt. of ice in 100 hours.

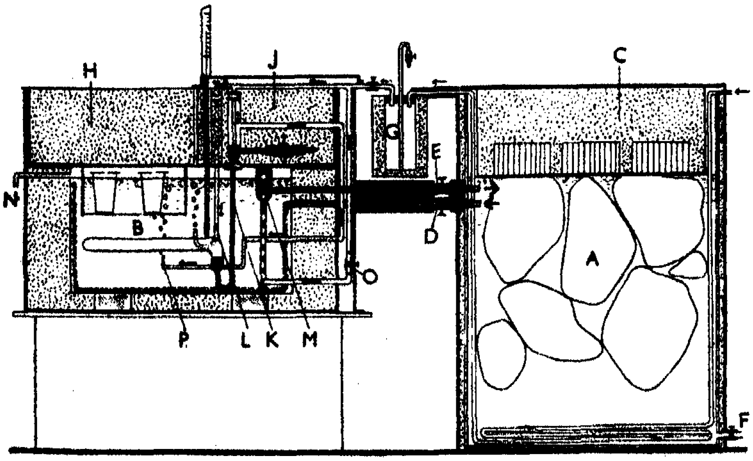

Fig. 1.

It consists of two tanks, A a large reservoir containing ice and water, and a small thermostat bath B, both of which are well insulated with powdered cork. A constant temperature in the bath B is maintained by a controlled circulation of water between it and the ice tank through the insulated tubes D and E. This flow is induced by a stream of air bubbles entering via O and streaming up the tube into the cup M, thus raising the level of the water in the latter and causing a flow via E into the ice tank. This is compensated by a back flow of cold water into the bath through D. The air is first cooled by passage through a coil at the bottom of the ice tank in order to prevent subsequent condensation in the thermo-regulator. Any water condensed in the coil is forced up and retained in the trap G. The air can then pass (1) through O to the circulator already described; (2) via the toluol-mercury gas regulator K to the bubbler P; or (3) direct to the bubbler L. When the bath temperature falls lower than that required, the air passage through the regulator is open and the tube diameters and taps are so adjusted that all the air is passing into the bath through the bubbler P, thus keeping the water stirred. When the temperature rises as a result of inevitable heat leakage from the air, the bubbler P is stopped by the rise of the mercury in the regulator and the air passes through the circulator and the bubbler L. The result is that the bath temperature is lowered by inflow of cold water while stirring is still maintained. The well-insulated lid of the thermostat bath is in two halves, one, J, into which are inset the thermometer, thermo-regulator and connexions, and the other, H, which is removable in order to give access to the experimental vessels resting on a wire tray. The lid C of the ice tank is weighted and so arranged that it touches the surface of the water at the required level. This prevents alteration in level due to melting of floating ice; that due to specific gravity changes is not sufficient to affect the apparatus and is readjusted when the ice is renewed. Preparatory to addition of more ice, the tubes D and E must be shut while the water is run off through F. An overflow N from the thermostat bath must be provided.

It is, of course, essential that the insulation should be protected against damp from the air or from possible leakage over the edges of the tanks, and that the tube connexions are thoroughly firm and watertight. There is no doubt that the efficiency and sensitivity of our present apparatus could be increased by improvement of certain details, particularly in insulation and in the form of the thermo-regulator. In the absence of a compressed air supply, we have found a Grafton electric aquarium aerator to be thoroughly satisfactory.

The apparatus could be used as a cold aquarium for larger animals if the bath B were made of glass or porcelain and the water circulated between this and a vessel suspended in A and surrounded by the ice and water. It might also be adapted for use at temperatures below 0° C. if brine were used, cooling being done by the suspension of a vessel in A containing a block of solid carbon dioxide.

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Production of Thin Gold Films

IN view of the interest attached to the investigation of the physical properties of thin metallic films, a new and easy method for producing such films of pure gold would seem to have special significance.

Certain organo-gold compounds or their derivatives and, particularly the simplest of such compounds, namely, diethylmonobromogold[1], $[Au(C_2H_5)_2Br]_2$, when dissolved in a suitable solvent such as ethanol to which alkali is added, undergo an interesting decomposition even at the ordinary temperature; the solutions become deeply coloured like those of colloidal gold and in a short time (seven to nine minutes at the ordinary temperatures) gold is deposited as a coherent film.

Brilliant films have been deposited on suitably prepared glass and other surfaces. By reflected light they appear as massive gold and by transmitted light they show the characteristic colours of thin gold films. The films are capable of being polished, but they can be produced in such a manner as to render this unnecessary. The thickness of the films can be varied by altering the conditions of the reaction and the quantities of the reactants.

The necessary starting material being available, the pure gold films are actually more easily produced than those of silver and are much more chemically inert. In spite of their opulent appearance as mirrors, the films of pure gold produced so readily and deposited on glass, etc., may have considerable scientific application.

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July 21.

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[1] Gibson and co-workers, *J. Chem. Soc.*, 2531 (1930); 2407 (1931); 860 (1934); 1024 (1935); 324 (1936). Gibson, Provisional Patent Specification, 17261/1937.

Spontaneous Electrical Charge of Fine Coal Dust

IN the last paragraph of their letter on "Some New Characteristic Properties of Certain Industrial Dusts" in NATURE of May 1, Prof. H. V. A. Briscoe and colleagues state: "On several occasions we have found that fine dusts which have become aggregated by settlement or have been for some time exposed to air appear to be much less reactive than when freshly formed. . . ." In this connexion I have obtained interesting evidence which has specific reference to the varying liability of fine dusts to spontaneous electrical charging also dependent upon pre-treatment.

Two samples of the same coal dust were respectively maintained at 80° C. in an oven for 24 hours and 36 hours, the latter being periodically stirred and turned. Representative results of the voltages generated on circulating these dusts were:

	Voltage of generated charge at same capacity	Weight
24-hour sample	344·0	3 gm.
,, ,,	747·5	5 gm.
36-hour sample	270·0	3 gm.
,, ,,	589·0	5 gm.

The ratio of charge generation is approximately 1·25 : 1 for 24 hour to 36 hour samples.

The residue of the 24-hour sample was then retained in the desiccator at N.T.P., whilst the 36-hour sample residue was further heated in the oven, and the charge divergences were confirmed as follows:

	Voltage of generated charge at same capacity	Weight
Desiccator sample	234·0	2 gm.
Oven sample	64·5	2 gm.

Fresh samples of the same coal dust were then used, and after varying treatments of sub-divided samples (2 gm. each), were found to generate charge as follows:

Treatment	Voltage of generated charge at same capacity
1. In desiccator overnight	256·9
2. In oven 1 hour	205·4
3. No. 2, after 2¼ hours in desiccator	240·8
4. Several days in oven	112·0
5. As No. 4, but turned over many times	87·8

The continuing loss of electrical activity with age of dust is shown.

From 1 and 2, drying with heat produces a lower charge than drying at normal temperature, hence charge variation is probably due to a heating effect, for example, either oxidation or gaseous adsorption on particle surfaces, or both. From 2 and 3, as the regeneration of activity on cooling in desiccator is not likely to be due to reversal of oxidation, it is likely to be due to gas re-adsorbed on cooling in desiccator to replace gas driven off by heating in oven. From 3, 4 and 5, as heating and agitation continue, electrical charge progressively decreases. The decrease, therefore, is probably due to continuing de-adsorption.

It seems, therefore, that the tendency to spontaneous electrical activity of a coal dust decreases with age of dust and with probable decrease of adsorbed films or molecules on the dust particles, and increases, despite age, with increase of such adsorption.

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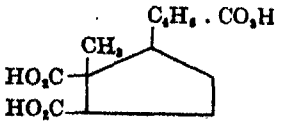
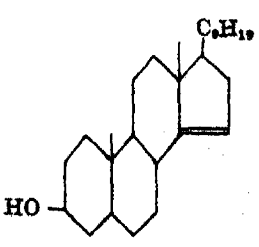
Stereochemistry of the Sterols and the Bile Acids

ALTHOUGH the stereochemistry of the *A* and *B* rings of the sterols and allied substances has been very fully developed, the evidence for the stereochemical configurations of the other rings rests on less secure grounds. The evidence for the *trans* fusion of the *B* and *C* rings rests solely on the requirements of a flat molecule as adduced from X-ray data, while that for the *trans* fusion of rings *C* and *D* is based on the isolation of the tricarboxylic acid (I) by the stepwise degradation of 12-ketocholanic acid[1] and desoxycholic acid[2]. This acid on pyrolysis gave an anhydride which on hydrolysis furnished an isomeric tricarboxylic acid. It was, therefore, deduced that the former acid had a *trans* configuration, from which it was assumed that the fusion of rings *C* and *D* was originally in the *trans* position. This conclusion would seem to be sound provided that no inversion occurred in the degradation, a loop-hole which cannot be excluded.



(I)



(II)

Recent work on the relative stabilities of *cis* and *trans* hydrindane derivatives leads to a different expectation and, in fact, the result of the catalytic hydrogenation of β-ergostenol (II) strongly suggests that rings *C* and *D* are in *cis* relation. Laucht[3] has shown quite conclusively that the double bond in this substance occupies the $C_{14:15}$ position. The original stereochemical configuration of the *C* and *D* rings has, therefore, been destroyed, yet, on catalytic hydrogenation in neutral solution[4] and even in acetic acid[5] (a solvent known to favour the formation of a *cis* configuration), β-ergostenol yields the same ergostanol as that obtained by the complete reduction of ergosterol. Ergostanol must, therefore, include a *cis* fusion of the *C* and *D* rings. As ergostanol is known to possess the *allo*-cholanic configuration, it would appear from this line of evidence that the *C* and *D* rings in the sterols and the bile acids are in *cis* relation also.

This result also supplies confirmatory evidence of the *trans* fusion of rings *B* and *C*, since, in the wandering of the double bond from ring *B* to ring *D*, the former two rings would be expected from known analogies to adopt their more stable configuration. This is further supported by the fact that inversions of 7-keto derivatives analogous to the facile isomerization of dehydrohyodesoxycholic acid to 3 : 6-diketo*allo*-cholanic acid have never been observed.

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University, Oxford.
July 8.

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[1] Wieland and Dane, *Z. physiol. Chem.*, **216**, 91 (1933).

[2] Wieland and Schlichting, *Z. physiol. Chem.*, **134**, 276 (1924).

[3] Laucht, *Z. physiol. Chem.*, **237**, 236 (1935).

[4] Reindel and Walter, *Ann.*, **452**, 45 (1927). Heilbron and Wilkinson, *J. Chem. Soc.*, 1708 (1932).

[5] Hart and Emerson, *J. Amer. Chem. Soc.*, **54**, 1073 (1932).

The *Cis*-form of Azobenzene

DURING determinations of the solubility of azobenzene, in which a photometric method of analysis was used, an apparent lack of reproducibility was traced to an increase both in the light absorption of standard solutions and in the concentration of saturated solutions, on exposure to light. The increases reached steady values after several days' exposure in a thermostat tank in a north-lit room. The increase of adsorption was shown to be nearly independent of light intensity, solvent and concentration, but was reached much more rapidly in bright sunlight—a few minutes sufficing for a *M*/2000 solution in a glass bottle. The phenomenon, persisting after repeated recrystallization of the azobenzene, seemed consistent only with a reversible formation of a polymer or isomer, both forward and backward reactions being activated by light and the thermal reaction being very slow at ordinary temperatures.

The second form was found to be distributed between immiscible solvents much more in favour of the more polar one than is ordinary azobenzene and a method of separation based on this property was devised. 5 gm. of azobenzene were dissolved in 250 c.c. of acetone and the solution exposed to sunlight for several hours. The following operations were then carried out in dim light. 350 c.cm. of water were added, the mixture cooled, filtered and extracted with 40 c.c. of light petroleum. The azobenzene left in the aqueous layer would have been extremely small if the acetone solution had not been exposed to light. That actually remaining was extracted by chloroform. The procedure was several times repeated and the chloroform extracts united, dried and evaporated down *in vacuo*. The product was crystallized from light petroleum between 25° and −15° C.

Solutions of successive crystal fractions were made up in acetone. The first few fractions had a constant absorption coefficient for the blue light used (that transmitted through a Kodak 'Wratten No. 47' gelatin filter) and this was 2·17 times that of ordinary azobenzene. On exposure to sunlight, the absorption of these solutions fell to a constant fraction, 0·61, of the original value. That of ordinary azobenzene rises on exposure to 1·32 of the original, the exposed solutions thus having identical absorption. It was assumed that the first crystal fractions were the pure second form. The equilibrium mixture would contain, therefore, about 27 per cent of the second form.

The melting point of the second form is at least one or two degrees higher than that of the normal form (68° C.). Successive determinations on the same sample gave melting points progressively lower at first, passing through a minimum at about 35°, and then rising to 68° C. Some thermal reversion may have occurred before the first determination, and the exact melting point is therefore in doubt. Thermal reversion is undoubtedly quicker in the liquid than the solid state, but some reversion had occurred in crystals that had been exposed to strong sunlight. In a sealed tube, with a mercury manometer attached, in which the azobenzene occupied about 1/10 of the enclosed air space, thermal reversion took place at 100° C. without change of pressure.

The polar character of the second form, which proves almost conclusively that it is the *cis*-isomer, a suggestion first due to Prof. S. Sugden, is indicated by its greater solubility, despite the higher melting point, in polar solvents, and smaller solubility in petroleum. Determinations of the dipole moment in benzene solutions, made by Dr. R. J. W. Le Fèvre, give a value of 3·0 Debye units. The apparent moment of the ordinary trans- form increased on exposure of a solution to light from zero to 1·4–1·5 while that of the *cis*-form decreased to the same value. The change indicates that the equilibrium solution contains between 20 and 25 per cent of the *cis*-form, in good agreement with an approximate estimate of 21 per cent by the photometric method, this value, in a *c.* 1 per cent solution in benzene, being somewhat lower than that, 27 per cent, found in much more dilute solution in acetone.

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Transformation of Hydrate Cellulose into Native Cellulose

IF cellulose is precipitated from solution or liberated from its compounds with sodium hydroxide, the space lattice (*a* = 8·14 A., *b* = 10·3 A., *c* = 9·14 A., β = 62°) differs from that of native cellulose (*a* = 8·35 A., *b* = 10·3 A., *c* = 7·9 A., β = 84°). In this form it is known as hydrate cellulose, although it is in fact of the same analytical composition as the native form, and is free from water. Hitherto it has not been possible to convert one modification directly into the other; it was possible to pass from native cellulose via alkali cellulose to hydrate cellulose, and from this (as Barry, Peterson and King[1] showed recently) by way of the ammonia compound back to native cellulose. Moreover, Hess and Gundermann[2] have described the appearance of native cellulose along with hydrate cellulose during the washing out of alkali cellulose at 100° C. We find, however, that it is possible to convert hydrate cellulose directly into native cellulose.

When strongly stretched hydrate cellulose in the form of viscose silk 'Lilienfeld silk' is heated for half an hour in water at 200° C., the X-ray diagram shows interferences characteristic of native cellulose as well as those of hydrate cellulose. The same diagram is obtained after treating viscose with boiling formamide (200° C. for half an hour). If the fibres are heated in formamide to 140° C., less native cellulose is formed than at 200° C.; after half an hour in glycerine at 250° C. the hydrate cellulose is converted almost completely into the native form. If the fibres are left for eight days in water at 200° C., very little more native cellulose is formed than after half an hour.

The same experiments were made with hydrate cellulose obtained by the mercerization of ramie. It was found that under the same conditions less native cellulose was formed from this material than from Lilienfeld silk.

Dry viscose heated for twenty minutes in a high vacuum at 200° C. remains unchanged; but after ten minutes at 300° C. a little native cellulose is formed. Water and other dipole-containing liquids appear to increase the rate of transformation very considerably.

Native cellulose (ramie) after heating for five days in water at 150° C. remains unchanged. We conclude that at least over the range of temperature covered by these experiments *native cellulose is the stable form, and hydrate cellulose the non-stable.*

As already indicated, Hess and Gundermann obtained native cellulose by the action of water at 100° C. on alkali cellulose. We have been able to detect native cellulose in preparations which were washed out at 60° C. If decomposition and washing out take place at 20° C. and the preparation is afterwards heated, no native cellulose is formed even at 100° C. On dipping fibres of alkali cellulose into formamide at 140° C. the product obtained is almost entirely native cellulose. In all these cases, therefore, the temperature necessary for the formation of native cellulose is considerably lower than that required for the transformation of hydrate cellulose as such into the native form.

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July 14.

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[1] *J. Amer. Chem. Soc.*, **58**, 333 (1936).

[2] *Ber. deutsch. chem. Ges.*, **70**, 527 (1937); see also Hess and collaborators in *Z. phys. Chem.*, B, 7, 7 (1930).

Isolation of Ascorbic Acid from Urine

HINSBERG and Ammon[1] have been unsuccessful in an attempt to isolate ascorbic acid from urine. Recently E. C. Noyons[2] has described a method for the isolation of ascorbic acid from tomato juice involving chromatographic adsorption, and has announced his intention of applying a similar procedure to the isolation of ascorbic acid from urine. We have been engaged for a considerable time on this problem and have finally isolated from urine a small amount of a crystalline dinitro-phenyl hydrazine derivative which appears to be that of ascorbic acid. Its melting point (269–271 uncorr.) agrees with that of the similar derivative prepared from pure ascorbic acid (m.p. 270–272) and the crystalline forms appear identical. A mixed m.p. with the dinitro-phenyl hydrazine derivative of the pure vitamin shows no depression (m.p. 271–272). The reliability of the m.p. determinations has been checked by taking a mixed m.p. of the 2 : 4 dinitro-phenyl hydrazine derivatives of ascorbic acid and salicylaldehyde (m.p. 249). A very marked depression was observed, both in this case and in another where a mixed melting point of two different hydrazones with very similar melting points was taken.

This work is being continued, and we hope shortly to be in a position to give a more complete account of this investigation.

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July 21.

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[1] Hinsberg, K., and Ammon, R., *Biochem. Z.*, **238**, 102 (1936).

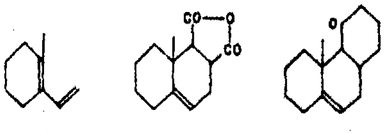
[2] Noyons, E. C., *Acta. Brev. Neerlandica*, 7, 79 (1937).

A Diene Synthesis applicable to the Sterol Group

THIS method is regarded as the most promising yet adumbrated in that it reduces the problem of the synthesis of cholesterol or its stereoisomerides and analogous substances to the much simpler one of preparing a monocyclic and a bicyclic intermediate. It seems to be especially important that the double bond of cholesterol is placed by this synthetic process in the correct position and that unlike many other diene syntheses the method can be used to introduce the angle-methyl groups.

1-Methyl-2-vinylcyclohexene (I), obtained from the known 2-methylcyclohexenylethyl alcohol by an application of the xanthogenate reaction, condenses with maleic anhydride in benzene solution with the formation of the anhydride (II), m.p. 111·5°. This and the related dibasic acid, m.p. 171°, afforded analytical values tallying with theoretical anticipations.

With crotonaldehyde the diene furnishes an adduct the dinitrophenylhydrazone of which has m.p. 192° and analysis of which agrees with the formula $C_{19}H_{24}O_4N_4$. The 2 : 4-dinitrophenylhydrazone of the adduct (III) from the diene and cyclohexenone has m.p. 164° and gives satisfactory figures on analysis.



(I) (II) (III)

Fig. 1.

The constitutions of the intermediates now required for the synthesis of substances containing the cholane skeleton are obvious on inspection, and attempts to make some of them are in progress.

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Antimicrobial Action of Some Aromatic Compounds

NUMEROUS recent researches have directed our attention to the antimicrobial action of various aromatic amino or nitro compounds containing the following functional groups: sulphamide, $\mathrm{R{-}SO_2NH_2}$; thio, $\mathrm{R{-}S{-}R'}$; dithio, $\mathrm{R{-}S{-}S{-}R'}$; sulphone, $\mathrm{R{-}SO_2{-}R'}$; thiophenol, $\mathrm{R{-}SH}$; sulphinic acid, $\mathrm{R{-}SO_2H}$. By chemical analogy with the arsenic compounds in which the arsenoxide group shows *in vitro* a very high parasiticidal activity, we have been led to a study of the para-substituted aromatic sulphoxides.

Experiments on mice have proved that 4 : 4′-diacetylaminodiphenyl sulphoxide (m.p. 292° C. uncorr.) and also other sulphoxides, symmetrical or asymmetrical, containing the groups OH, NH_2 or NO_2 in the *para*-position, administered by mouth, show an extremely high curative activity not only against *Streptococcus*, but also against experimental gonococcal infection.

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Points from Foregoing Letters

BY feeding a dog with oil and with radioactive phosphorus (as sodium phosphate) and then determining the proportion of 'labelled' phosphorus in the lecithin of the blood and of the intestine, Prof. G. Hevesy and E. Lundsgaard find that the additional lecithin found in the blood contains only a small amount of the active phosphorus, and conclude that during the absorption of neutral fats lecithin is formed outside the intestinal tract.

Drs. J. R. Edisbury, J. A. Lovern and R. A. Morton state that fish viscera other than liver contain vitamin A, and that halibut viscera constitute a very rich and hitherto neglected source of the vitamin. Evidence is adduced that vitamin A in liver is, at least in part, associated with protein.

From the intensity of the components of the hyperfine structure of the resonance line of potassium, Dr. D. Jackson and H. Kuhn deduce that the magnetic moment of K39 is positive, and that the nuclear spin has a value of 3/2, in agreement with the findings of Millman, Fox and Rabi. The centre of gravity of the components of K41 overlaps the weaker component of K39.

An increase in the number of kicks in a 'neutron' counter when placed inside a lead chamber leads B. Arakatsu, K. Kimura and Y. Uemura to assume that neutrons are liberated from lead by cosmic ray photons. When the lead chamber is filled with paraffin, a further increase in the number of kicks of the counter is observed.

Investigations of oxide films on iron by means of electron diffraction throws further light on the three oxide layers (composed of ferrous, magnetic and ferric oxide). T. Iimori gives a diagram showing the regions of stability of the various forms of iron oxide and concludes that, with rising temperature, iron atoms migrate more vigorously towards the surface and check any further oxidation of the lower oxides.

N. S. Nagendra Nath states that the asymmetry in the curve showing the energy distribution of the electrons emitted by radioactive substances (β-decay) is explainable on the assumption that the final process consists of a shower of neutrinos, the number in the shower depending on the transition energy of the nucleus.

An inexpensive low-temperature thermostat, useful also as a cold aquarium, is described by L. C. Beadle and F. A. Booth. A constant temperature is maintained by means of a controlled circulation of water from an ice tank, the flow being induced by a stream of air bubbles in a connecting tube.

Prof. C. S. Gibson directs attention to the production of thin gold films or mirrors on glass and other surfaces by deposition from organic gold compounds such as diethylmonobromogold.

Dr. S. C. Blacktin describes experiments indicating that, with a fine coal dust, its spontaneous electrical activity varies with the treatment to which the dust is submitted, and that such activity seems to increase with the increase of adsorbed material on the particles and to decrease with decrease of such adsorbed material.

D. A. Peak discusses the evidence concerning certain aspects of the structure of sterols and bile acids and suggests that the fusion of the *C* and *D* rings is in the *cis* and not in *trans* position as hitherto believed.

The separation of the *cis* form of azobenzene by extracting an acetone solution exposed to light with water and then further extracting the aqueous solution with chloroform is described by G. S. Hartley. The *cis* and *trans* forms come to equilibrium under usual conditions, the change being activated by light. The *cis* form has a greater absorption coefficient for blue light and its melting point is somewhat higher than that of normal azobenzene. In benzene solution it has a dipole moment of 3·0 Debye units.

By heating strongly stretched hydrated cellulose (viscose silk) for half an hour at 200° C. in water or in formamide, Prof. K. H. Meyer and N. P. Badenhuizen, jun., find that it is changed into native cellulose, as shown by X-ray diffraction patterns. The authors consider that at 200°–300° C. native cellulose is the stable form and hydrate cellulose is the non-stable.

A small amount of a crystalline dinitro-phenyl hydrazine derivative which appears to be that of ascorbic acid has been separated from urine by Dr. C. P. Stewart, H. Scarborough and Dr. P. J. Drumm.

A diene synthesis which may help towards the synthesis of cholesterol and similar substances is described by A. B. Meggy and Prof. R. Robinson.

Research Items

'Woman Marriage' in Dahomey

THE institution of a form of marriage in which one woman takes another to wife has been recorded in Africa among peoples so far distant from one another as in northern and southern Nigeria, the Anglo-Egyptian Sudan and the Union of South Africa. It was observed by Dr. Melville J. Herskovits in Dahomey in 1931 (*Africa*, **10**, 3). Dahomean marriages take thirteen different forms, falling into two general classes, in one of which, 'woman-with-money' are comprised all forms in which the marriage dues are paid by the spouse to the bride's father, while in the form 'friend-custody' no such payment is made. A woman may marry another woman, paying the dues and performing all the duties required in the first class; but nevertheless her marriage is spoken of as if it belonged to the second. In the first class of marriage the resultant offspring are under the control of the father; but in the second the mother retains control of her children. Woman marriage is rare among commoners, but frequent in upper-class families, particularly among royalty. It is based on the fact that women frequently become wealthy. They may then wish, especially if barren, to build up a compound of their own. To effect this a wife is married to whom the 'husband' admits a male friend or member of her household, the children who may result being regarded as her own, and competent to inherit the property of the house she has built up on this basis. The marriage does not necessarily imply homosexual relations. The motivating force, the desire for prestige and economic power, reflects the dominant Dahomean patterns of thought and the fundamental forces that underlie their behaviour. No stigma is attached to the parties contracting such marriages, and in fact the woman 'husband' is respected on account of her wealth and the number of persons she controls in her compound.

Prontosil in Puerperal Infections

IN the Section of Obstetrics and Gynæcology of the British Medical Association during its recent meeting in Belfast, Mr. G. F. Gibberd opened a discussion on the use of prontosil and similar compounds in the treatment of puerperal infections caused by hæmolytic streptococci. After a preliminary reference to dosage, he compared a series of 157 cases of puerperal infection treated at Queen Charlotte's Hospital with a control series treated in this hospital during the last two years before the introduction of the new drug. The death-rate was much reduced, and the time spent in hospital was much shorter in prontosil-treated cases. Dr. Doris Brown reported on the use of prontosil in the Royal Maternity Hospital, Belfast. For the three years before the introduction of prontosil the death-rate for cases of septicæmia was 87·5 per cent, and the mortality for all cases due to infection by the hæmolytic streptococcus was 23·5 per cent. Since the use of the drug the death-rate in cases of septicæmia was 28·57 per cent, and for all cases of puerperal infection 6·6 per cent. Prof. Chassar Moir referred to the remarkable effect prontosil had in combating *B. coli* infections of the urinary tract.

Factors of Vocational Guidance

IN an article in the *Human Factor* (**11**, Nos. 7–8), Dr. Oeser discusses the problem of vocational guidance. He believes that while most people acknowledge its importance, few recognize its complexities. He analyses some of the psychological aspects affecting individual cases, and points out the interrelation between these and social and economic factors. He considers the problem for those who leave school at the age of fourteen years. Economic and social factors, he says, limit the individual's sphere of choice. The child of poor parents must earn an immediate living; an individual may have both the ability and the inclination to enter a certain trade, but may be forced by the condition of the labour market into another for which he has the ability but not the inclination; opportunities of employment vary in different neighbourhoods; the social status accompanying each occupation varies; the tradition of the family circle will give arbitrary value to certain kinds of work. The psychological factors fall into two parts: those that determine technical ability, and that depend on physical, temperamental and intellectual endowments; and those that determine personal choice and preference. Physical and intellectual endowments are measurable; but temperamental fitness is more difficult to assess, and together with the factors determining personal choice has its source in unconscious mental processes. Thus the data that are required for adequate vocational guidance range from the more general psycho-biological through social and economic to the deeply individual.

Sexual Periodicity

IN a paper (*Proc. Roy. Soc.*, B, **123**, 413; 1937) which is really a supplement to the Croonian Lecture given by him in 1936, Dr. F. H. A. Marshall summarizes evidence of the factors controlling the sexual seasons of various animals. Ruminants breed when the days are getting shorter, whether they live in the northern or the southern hemisphere. Individual ruminants which have been transported across the equator have been known to adapt themselves at once, and have two rutting seasons in one year. Ruminants on the equator usually have no sexual season. Most other mammals breed in the spring, and species transferred from the northern to the southern hemisphere conform to the seasonal conditions of the south. The same is generally true of birds. Rowan showed that, in some birds in any event, the lengthening of daylight was the important factor causing the onset of the sexual season. Similar experiments have been done with various other animals, and although it has frequently been found that light increases sexual activity, this is not always so.

Biology of Plankton Animals

MUCH information of interest is given on the biology of three important plankton organisms, *Calanus finmarchicus*, *Sagitta setosa* and *Sagitta elegans*, in the North Sea by R. S. Wimpenny (Min. Agric. Fish., Fishery Invest., Ser. II, **15**, No. 3, 1936, pp. 1–53, 1937). The seasonal observations have been based mainly on a line of stations between Flamborough Head and the south-west patch of the Dogger Bank. Detailed observations were made on the breeding, growth and feeding of the three species, and have afforded a welcome extension to somewhat similar knowledge gained at Plymouth and Millport. All three species tended to be smaller than at Plymouth; this was thought to be connected with the shallow conditions of the southern North Sea, there being, for example, a decrease in size of *S. setosa* in the North Sea from north to south. The breeding periods of *Sagitta* also appeared to be fewer than at Plymouth. It appears that *S. setosa* is characteristic of mixed North Sea or 'Bank' waters, while the other two species occur in water of more oceanic origin. Additional information is given on the relation between zooplankton and phytoplankton, and the suggestion is put forward that phytoplankton concentrations may play the part of breeding and nursery grounds for zooplankton species.

Bacteriosis of Cherry Trees

THE serious damage caused by bacterial 'die-back' of sweet cherries in many English orchards is described in a recent paper by H. Wormald (*J. Pom. and Hort. Sci.*, **15**, 1, 35; 1937). The symptoms consist of stem, crotch and branch cankers, shoot wilt, bud and spur blight, leaf spots and occasionally fruit spots. Certain varieties have proved to be commonly attacked, and some varieties seem to suffer less than others. Two organisms, *Pseudomonas prunicola* and *P. mors-prunorum*, have been isolated from a number of infected trees and are regarded as responsible for bacteriosis of sweet cherries in Great Britain. The latter, which also causes bacterial canker in plums, is more widespread. Control is difficult, but infection may be reduced by avoiding mechanical injury, such as pruning, in autumn, winter and early spring. Infected parts may be excised early in the year and the wounds covered with an antiseptic dressing. Mercury-glycerine or zinc chloride is suggested. Some control has been achieved by spraying with Bordeaux mixture in autumn, but several varieties suffer foliage damage with this treatment. There is no evidence that application of lime to the soil induces resistance to bacteriosis. Stocks as well as varieties vary in susceptibility, and it is possible that suitable resistant stocks may be found on which to graft susceptible varieties. Some interesting observations on the susceptibility of different varieties at East Malling are described (*ibid.*, p. 25) by N. H. Grubb, and certain questions of nomenclature and the effect of local conditions are discussed.

Crosses between Radish and Turnip

RECIPROCAL crosses were made between radish ($n = 9$) and turnip ($n = 10$) by Messrs. L. E. Morris and R. H. Richharia (*J. Genet.*, **34**, No. 2). With turnip as female parent, 428 flowers yielded 23 seeds, 19 of which germinated. Their characters indicated that they were diploid hybrids. In the reciprocal cross, from particular parent plants 128 flowers yielded 5 seeds. Two of the resulting plants were like radishes (accidental selfs ?), one was like the reciprocal hybrids and one was triploid, having $2n = 28$ chromosomes. It probably came from the fertilization of a diploid radish egg-cell. This triploid hybrid open-pollinated gave a varied progeny, including two hexaploids with $2n = 56$ which resembled the triploid but were almost sterile. The functional eggs of the triploid plant were chiefly triploid, but some had 9 chromosomes and were genetically like the radish. The pollen of this plant also showed a range from 9 probably up to $3n$, but when used on radish the functioning grains had mostly 9 but some had 10 chromosomes. Triploid pollen grains apparently did not function on the radish stigma.

Roaring Sands of the Kalahari Desert

MR. A. D. LEWIS has recently given an interesting account of these sands (*S. African Geog. J.*, **19**, 33–49; 1936). They lie at the south end of an elongated patch of whitish sand dunes near the south-east corner of the Kalahari desert, and the roars are heard most intensely along the southern face, which rises nearly 100 ft. at a slope of about 1 in 2. Compared with the rest of the desert sands, the grains are perhaps more rounded and of a more uniform size and shape. Mr. Lewis describes two types of noise, a roar caused by pushing the sands forward in a heaped-up manner and a hum by keeping the sand moving slowly down the slope. A very loud roar is produced by sitting on the slope and sliding down it in slow jerks. In the still of the early evening or morning, such a noise is easily heard, like the rumbling of distant thunder, at a distance of 600 yd. Merely moving the fingers up and down the sand produces a roar, the upward motion giving a higher note than the downward. Samples of the sand were taken in bags to Pretoria, and it was found that a roar was obtained by tilting the bag over sharply when half empty. If the bags were left open, the roar was lost after a few weeks, though it could be restored for a short time by heating the sand in an oven.

Mineral Position of the British Empire

A REMARKABLY comprehensive and instructive publication on the mineral industries of the British Empire has recently been issued under the above title, by the Mineral Resources Department of the Imperial Institute (pp. 166, price 4*s*.). Commencing with a comparison between world and Empire outputs of all the more important minerals used in 1929 and 1935, the work goes on to survey the many changes bearing on production that have occurred during this period. Graphical illustrations of the variations in annual outputs of twelve essential commodities are given. It appears that the Empire as a whole is largely dependent on foreign sources of supply for eight mineral products only—antimony, borates, molybdenum, petroleum, potash, pyrites, mercury and sulphur. Many interesting facts are brought to light by the authoritative statistical data presented. Thus, in 1935 the Empire produced 86·6 per cent of the world's nickel and 68·2 per cent of the world's asbestos, but both these percentages are considerably lower than in 1929. Also, in spite of a greatly increased output of gold, the Empire proportion fell from 72·7 per cent in 1929 to 58·3 per cent in 1935. There have also been decreases in the Empire percentages of chrome ore, manganese ore and diamonds. On the other hand, there have been decided increases in the Empire percentages of copper and lead ores. The total value of the Empire's mineral output during 1935 was about £400,000,000, of which the United Kingdom contributed nearly 42 per cent, South Africa a little more than 21 per cent and Canada 16 per cent. It is a striking fact that the value of the coal output of the United Kingdom represents about 37 per cent of the total value of the whole of the

Empire output of all minerals. All who are concerned with mineral industries or with Empire problems in relation to world affairs will find this volume indispensable.

Cyclone Series in the Caribbean Sea

At a meeting of the Royal Meteorological Society on May 26, a paper was read by E. Kidson entitled "The Cyclone Series in the Caribbean Sea, October 17–24, 1935". The author mentioned the view held by some who have attempted to apply frontal methods of analysis to tropical cyclones that air which has passed across the equator acts as the cold air. He referred to fronts found by K. R. Ramanathan and K. P. Ramakrishnan in Indian depressions of July and August, in which old monsoon air heated over India performed the role of the warm air-mass and fresh monsoon air the role of the cold air-mass; but stated that in the south-western Pacific the colder air of tropical cyclones undoubtedly came from higher southern latitudes and not from the far side of the equator. The paper is concerned with cyclonic developments encountered by the author on two occasions when he was crossing the Caribbean Sea after passing through the Panama Canal, and is illustrated by a series of synoptic charts with frontal analysis. In these he found more than one case where the warm air-mass clearly arrived from the south or south-west after having crossed the equator, in contradiction to the theory mentioned above, but in support of the observations in the south-west Pacific. It was noted, however, that air entering the Caribbean Sea from the south-west has first to cross the cold waters south of Panama and that such air will tend to be chilled in its lowest layers in consequence. This may easily lead to the warmth of the current as a whole being overlooked and thence to its being mistakenly regarded as the cold supply in any frontal development on account of its relatively low surface temperature.

Cyclol Theory of the Structure of Insulin

Until recently the only comprehensive theory of protein structure was the polypeptide chain theory put forward by Emil Fischer. This is somewhat difficult to reconcile with the globular character of the soluble protein molecules first indicated by Svedberg's ultra-centrifuge measurements and later also supported by X-ray measurements on pepsin and insulin, and it is evidently of the greatest importance that other theoretically possible arrangements of amino-acids should be considered. One such has been examined in detail by Dr. D. M. Wrinch, who has shown that it might be possible to unite amino-acid residues through imino links in a laminar pattern—the cyclol structure. This laminar structure may then be folded into a restricted number of geometrically plausible space enclosing networks. For insulin, Dr. Wrinch proposes a cyclol structure built out of 288 residues united in a network of this kind which covers the surface of a truncated tetrahedron (*Science*, 85, 566; 1937). This polyhedral configuration would give the molecule the globular character required by Svedberg's data, and also the trigonal symmetry suggested by the X-ray evidence, provided that the actual amino-acid residues are symmetrically distributed over its surface. Along the trigonal axis the dimensions of the cyclol molecule would fit it fairly closely into the crystal unit cell, but at right angles to this there is very much more space, and it is suggested that this is filled by tyrosine residues held together by zinc or other cations. Very much more experimental evidence is, of course, necessary before such a structure could be considered established, but in any event the construction of the models proposed is of great interest.

Projection Television

At a convention of the Institute of Radio Engineers held on May 10–12, several papers were presented dealing with recent developments in television. Two of these, by Dr. V. K. Zworykin, Mr. W. H. Painter and Dr. R. R. Law, described the development of a new electron tube by means of which an enlarged, projected image may be obtained of the picture normally seen on the fluorescent screen of a cathode ray tube. Some brief details, with an illustration of the device, are given in the June issue of *Electronics*. The tube illustrated contains an electron gun capable of delivering about 1·5 milliamperes at the cathode, of which about 0·4 milliampere is actually delivered to the beam itself. The beam is accelerated by a potential of 10,000 volts on the last anode, and the resulting picture on the fluorescent screen itself, although only 2 in. × 1½ in. in size, is of exceptionally high brilliance. The tube is intended for use with a lens of $f/1 \cdot 5$ aperture, and the standard size for the projected picture is 18 in. by 24 in., for which the illumination compares favourably with that of the ordinary 16 mm. home cinema picture. The screen material used in this tube is principally zinc orthosilicate of carefully controlled crystalline structure, which gives a brilliant yellow-green light and which is very stable under prolonged heavy bombardment. At the meeting referred to above, a demonstration of the operation of this projection tube was given by the engineers of the Radio Corporation of America. A video signal was obtained from a still picture using 30 frames a second and 343 lines without interlacing. A special screen, about three by four feet in size, was employed, and the picture obtained was of high brilliance and quality. As an additional demonstration, the small screen was removed and the image projected on to the standard screen used for lantern slides. In this case, the picture was 8 ft. × 11 ft. in size and was stated to be readily visible to all those present in the room, which was about fifty feet long.

Masses and Parallaxes of Binary Stars

Dr. C. Barnes has published a paper on the statistical determination of masses and parallaxes of binary stars (*Mon. Not. Roy. Astro. Soc.*, 97, 6; April 1937), in which he submits the mean values of $\rho\omega^3$ and $(\rho\omega^3)^{\frac{1}{3}}$ for orbits of given eccentricity, these quantities appearing in the equations used for determining the combined mass and the parallax respectively. In addition, he gives the mean values for $(\rho\omega^3)^2$ and $(\rho\omega^3)^{\frac{2}{3}}$ which are required for the estimation of the probable errors. From 124 orbits as computed by Prof. R. K. Young, it is found that with the mean value of e between 0 and 1, $\overline{e^2} = 0 \cdot 322$ and $\overline{e^4} = 0 \cdot 14$; from which $\overline{\rho\omega^3} = 16 \cdot 9(a^3/P^2)$ and also $(\overline{\rho\omega^3})^{1/3} = 2 \cdot 38(a^3/P^2)^{1/3}$. In the first case, the probable error in a single determination is 49 per cent, and in the second case it is 21 per cent. If a somewhat different mean value of e be taken, the numerical results are essentially unchanged. For example, if $\overline{e^2} = 0 \cdot 263$, $\overline{e^4} = 0 \cdot 11$, the coefficients given in the above equations become 17·3 and 2·42 respectively, very small changes for a considerable change in e.

Royal Society of Canada

ANNUAL MEETING AT TORONTO

THE annual meeting of the Royal Society of Canada was held at the University of Toronto on May 25–28, under the presidency of Mr. Lawrence J. Burpee of Ottawa, who took as the subject of his presidential address "*The Discovery of Canada*". The Flavelle Medal for 1937 was awarded to Dr. F. D. Adams, the Lorne Pierce Medal to Prof. Stephen Leacock, and the Tyrrell Medal to Mr. Aegidius Fauteux. Prof. A. G. Huntsman, consulting director of the Biological Board of Canada and editor of its publications, and professor of marine biology in the University of Toronto, was elected president for the year 1937–38.

In Section 1 (French, Literature, History, etc.) fifteen papers were read, and in Section 2 (English Literature, History, etc.) twenty-one papers.

In Section 3 (Chemical, Mathematical and Physical Sciences) 142 papers were presented, 47 by title only. One third were presented to the whole Section, the remainder to four subsections (Astronomy, Chemistry, Mathematics, Physics). Three new fellows were elected to the Section: Profs. A. R. Gordon, of the University of Toronto; R. L. Jeffery, of Acadia University, and W. H. Watson, of McGill University.

The feature of the meetings of Section 3 was its presidential address by John Patterson, director of the Meteorological Service of Canada, in which he outlined recent advances made in this service. The necessity of a continuous forecasting service for the recent expansion in aviation has given a new impetus to research, has led to increase in the number of observation centres, and has increased the personnel. The address was followed by a symposium by A. Thomson and various members of the meteorological staff, in which the results of temperature, water vapour content, and pressure distribution in the upper atmosphere at various Canadian stations were given. Observations at the National Research Laboratory, communicated by D. C. Rose, showed that the advance of polar front is the cause of variations in potential gradient.

Prof. L. Gilchrist presented a paper on resistivity measurements at the Chickamauga Dam site, Tennessee, where underground caverns were located by the proper use of 'Megger' instruments. A survey of methods used to determine overburden above magnetic deposits by magnetic methods with field examples was given by Prof. D. A. Keys. Dr. W. H. Martin dealt with the Raman spectra of some oximes, and pointed out the shift of one Raman line due to addition of hydrochloric acid to certain amines and to mercuric chloride in solution. Prof. J. A. Gray gave the results of the scattering of X-rays at small angles by charcoal, and presented further evidence that some β-rays lose energy when scattered through large angles by nuclei.

The Rev. A. Vachon presented an interesting account of the salinity of the water at different points in the estuary of the St. Lawrence River; from these measurements, arctic currents can be traced, especially along the north shore, and also the course of the water from the Saguenay after it enters the St. Lawrence. Prof. E. H. Boomer, speaking on phase equilibria in hydrocarbon systems, showed that the behaviour of the systems relative to one another can be predicted qualitatively from the chemical and physical properties of the liquid hydrocarbons used. Results of experiments by Prof. C. C. Coffin on the effect of molecular structure on the rate of unimolecular gas reactions show that the replacement of hydrogen by chlorine atoms produces a slight decrease in rate, while introduction of a double bond gives a fourfold increase. Prof. W. Lash Miller presented a group of papers on Wilders' bios and yeasts. Of fourteen papers presented by Prof. O. Maass and his students, one on the measurement of the specific heat of propylene in the critical pressure – critical temperature region contained an account of a new type of adiabatic calorimeter, and it was shown that the liquid state of aggregation persists above the critical temperature. Prof. H. Hibbert (with F. B. Pickett and G. F. Wright) reported on the relative acidity of carbohydrate hydroxyl groups; they find that the hydroxyl group attached to the C_4 atom in glucose is more acid than those attached to the C_2, C_3 and C_6 atoms.

Prof. W. H. Watson presented a paper on the electron and the limits to the precision of electromagnetic field specifications, in which the uncertainty relations of the electromagnetic field are applied to determine the corresponding uncertainties in the motion of an electron in the field. Prof. J. L. Synge presented several papers by his associates, of which one on the problems of the beam and the plate in the theory of elasticity, by J. N. Goodier, was of particular interest, as it proved that the engineering theories of beams and plates are good to a high order of approximation under the conditions of use. Prof. A. F. Stevenson gave a paper on a generalization of Oseen's equations for steady flow past a fixed obstacle, with application to the sphere, and Prof. R. L. Jeffery another on sequence integration and non-absolutely convergent integrals for functions of two or more variables. A paper by Prof. W. L. G. Williams and M. S. MacPhail on functions of the complex variable $z = x + jy$, where $j^2 = c^2$, was of particular interest, and mention may also be made of a paper by Prof. S. Beatty and D. C. Murdoch on routine for determining the numbers e, m associated with a cycle $f = o(p)$ of an algebraic equation $F = 0$.

Prof. H. A. McTaggart demonstrated the ellipticity of the light reflected at the surface of films of oriented molecules. Prof. A. L. Clark gave the result of the experimental determination of the probability of a steel ball falling through one of a number of holes in a plate. Prof. E. F. Burton presented a number of papers describing work done in the McLennan laboratories. The specific heat of tributyrin at low temperatures has been measured by J. O. Wilhelm and A. H. Woodcock, who find that it varies from 0·4 cal./gm. at room temperature to 0·012 at 16° K. H. E. Johns and J. O. Wilhelm have determined the refractive indices for λ 5461 A. of liquid oxygen (1·2242), liquid nitrogen (1·1990) and liquid hydrogen (1·1120). J. M. Anderson has determined the half lives of several lines in the spectrum of argon II by a modified canal-ray method; all so far measured have a half life of less than 10^{-8} second.

In the Geological Section (4) eighteen papers were presented. Three new fellows were elected: Dr. G. W. H. Norman, of the Geological Survey of Canada; Prof. F. F. Osborne, of McGill University, and Dr. J. F. Walker, provincial mineralogist of British Columbia. Among the interesting papers presented the following may be mentioned.

Prof. G. H. Henderson (of Section 3) described two new types of pleochroic haloes in biotite, and showed that they are invariably associated with minute fissures through the mineral. He indicated that they originated from certain members of the radium family of very short life-period, and suggested that precipitation of minute grains of radium-bearing minerals from the fissure-filling solutions probably accounts for the localization of the haloes.

The last paper of the late Dr. W. H. Collins, formerly director of the Geological Survey of Canada, was presented by H. C. Horwood, who had assisted him with much of his field work. Results of several years of detailed study of the Sudbury district strongly confirm the original conclusions of Dr. A. P. Coleman as to the magmatic origin of the ores, and indicate that secondary processes play a relatively minor part in ore deposition. Dr. Coleman, now eighty-five years of age, was present at the meeting to hear this vindication of his conclusions.

H. C. Cooke presented new data on the age of the Dore series of Michipicoten district, Ontario, based on determinations of the structure of the Keewatin lavas, and concluded that the Doré series is probably of Temiskaming age, and is not interbanded with the Keewatin as previously supposed. W. C. Gussow presented the results of his work during tenure of one of the Carnegie fellowships administered by the Society. These indicate that the gold deposits of the Rouyn area, Quebec, are not primarily related to the granitic stocks, but were deposited from soda-bearing solutions introduced along fissures at some later date. The solutions albitized the intrusives and caused profound petrographic changes in them.

In Section 5 (Biological Sciences) sixty papers were presented, in part before the whole section, and in part to two subsections (Zoology and Botany, and the Medical Sciences). Profs. D. L. Bailey and G. F. Marrian of the University of Toronto and Dr. J. H. McDunnough, of the Division of Systematic Entomology of the Dominion Department of Agriculture, were elected fellows of the Section.

Prof. E. M. Walker gave the sectional presidential address on "*Grylloblatta*, a Living Fossil", and showed a very interesting cinematograph film of this prehistoric beetle from the Canadian Rockies, proving, *inter alia*, that the heat of the hand rapidly causes its complete prostration, while contact with ice leads to slow recovery. Prof. A. G. Huntsman traced the cause of the scarcity of salmon which occurs periodically in the Atlantic provinces every nine or ten years, as due to a succession of dry summers (also occurring periodically) which result in such lowering of the water of salmon streams that the young salmon parr are clearly exposed to kingfishers and mergansers, which take an unusually large toll. He also communicated an account of W. H. Johnson's study of the effect of light on the marine copepod *Acartia clausi*, which shows that movement is brought about by changes in intensity of light (upwards with diminution, downwards with increase of intensity), rather than by the degree of intensity itself; under static light conditions, the animals gradually become uniformly distributed.

Dr. J. W. MacArthur reported from his studies of finger and palm prints that left and right hands are as different in identical as in fraternal twins, while hands of the same side are quite similar in identical twins, but show large and increasing differences in the series: fraternal or sib pairs, parents and children, and unrelated persons. By such comparisons, the twin type can be correctly diagnosed in about half the pairs from their own prints alone, and in nearly all when prints of their parents and sibs are also available.

Prof. G. W. Scarth presented a paper by D. Siminovitch showing that the cells of plant tissues frozen internally with intra-cellular ice formation always die, while those dehydrated by external (intercellular) ice will survive, even after extreme dehydration of the protoplasm. Prof. Marie-Victorin and the Rev. J. Rousseau gave a paper extending the former's theory of the development of the flora of the St. Lawrence valley. R. B. Thomson described comparative studies of the 'inversed' bundles of male and female cone scales in a series of conifers, confirming the view that these are homologous structures which during growth come to assume different positions in association with the function of the scales as sex organs. Prof. W. P. Thompson presented several papers by himself and co-workers dealing with genetic problems in wheat and other cereals. Prof. A. H. R. Buller reviewed the life-history of the wheat rust, and reported new discoveries concerning the fusion in pustules on the barberry leaf of pycnia with a hypha of opposite sign.

Prof. J. W. MacArthur presented a paper by C. K. Gunn giving an account of a strain of rats which has, as a monofactorial autosomal recessive mutant character, acholuric jaundice resembling that in man in its chief clinical and genetic features. A paper by A. E. Allin (presented by Prof. D. T. Fraser) showed that, in general, skin sensitivity to diphtheria toxoid develops within three weeks during an attack of diphtheria in those who are initially non-sensitive, and increases at this time in those initially sensitive in some degree.

Prof. G. F. Marrian (with G. C. Butler) showed that an ether-soluble fraction from two women with adrenal tumours contained unusual amounts of pregnandiol, and also a triol, $C_{21}H_{36}O_3$, melting at 243–244° C. R. G. Sinclair adduced evidence that the red blood cells of the dog and the cat do not take part in fatty acid transport. E. G. Young gave an interesting account of prolonged study of purine metabolism in the Dalmatian coach hound from early age to adolescence.

Prof. C. C. Macklin described the detailed histology of the pulmonic alveolar walls of the adult cat, illustrating his paper by beautiful slides from photomicrographs, and stressed the presence of many 'bare areas' devoid of nuclei.

Prof. F. G. Banting presented a number of papers from workers in the Banting Institute of the University of Toronto. W. R. Franks and H. J. Creech have succeeded in forming chemo-antigens by coupling 1:2:5:6-dibenzanthracene and similar compounds to proteins, and injecting the products into rabbits, guinea pigs, and rats; formation of haptene specific antisera was demonstrated by precipitin reactions and by specific inhibition with the prosthetic substances. H. F. Richardson showed that death from intra-venous air embolism in dogs depends on the rate of injection; at very slow rates surprisingly large amounts of air can be injected before death ensues (through failure of the pulmonary circulation). B. C. Coles showed that the type of death in cases of criminal abortion, commonly ascribed to small amounts of air found in the heart at post-mortem, may be due rather to lethal amounts of toxic substances (such as potassium soaps) in the douche solution having entered the blood stream from the uterine cavity. According to D. Irwin, the tissue response to different samples of quartz is practically identical. W. R. Franks, L. D. Proctor and A. Duncan described a photo-electric dust estimator, designed to measure accurately and rapidly dust retainable by the lungs and therefore to estimate the dust hazard.

Recent Aeronautical Research

THE report of the Aeronautical Research Committee, issued recently*, deals with a period of nearly two years, from April 1935 until December 1936. This is to cover a change of procedure, future reports being issued for the calendar year. The report opens with a well-merited tribute to the memory of Sir Richard Glazebrook and Sir Joseph Petavel, who died during the period under review. They were both original members of the Advisory Committee for Aeronautics, appointed in 1909, and all who have had any connexion with aeronautics will appreciate how much the development of the science owes to them.

The outstanding feature of the period under review has been the increase in, and the still further demands for, high performance of aircraft. The major part of the Committee's activities are obviously directed towards this object. It is emphasized that the more recent equipment at the National Physical Laboratory and the Royal Aircraft Establishment, although elaborate and expensive, have made possible advances in the fundamentals of aircraft aerodynamical design to an extent that could never have been accomplished by the trial-and-error methods of full-scale experimental flight alone. The compressed air tunnel and the one-foot high-speed tunnel at the former, and the 24-ft. wind tunnel at the latter, are cases in point.

The 24-ft. tunnel at the R.A.E. has been used principally for the investigation of engine-cooling problems. At high translational speeds, theory shows it should be possible to provide enough cooling without adding at all to the drag of the complete aeroplane, and this prediction has been supported by experimental results. As the induced drag at high speeds is very small, it follows that a well-designed aircraft travelling at high speed need have a drag very little higher than that due to the friction between its exposed surfaces and the air.

Aeroplane speeds are now almost approaching the range in which compressibility becomes important, and the Committee, by undertaking research on compressibility effects, is taking steps to have information available by the time it is required. The apparatus used for this work is a one-foot high-speed tunnel, run from the exhaust of the compressed air tunnel. Tests on thick aerofoils have been done, and suggest that it may be necessary to take account of 'compressibility drag' when speeds of flight exceed four hundred miles per hour.

Much of the time of the compressed air tunnel has been devoted to investigations of surface friction. At the Reynolds numbers of flight a surface roughness corresponding to excrescences of the order of one-thousandth of an inch in height may be enough to increase the friction substantially. This measure of roughness is inappreciable at Reynolds numbers corresponding to those in ordinary atmospheric tunnels, so that although roughness may produce a difference in the behaviour of an actual aeroplane, the cause was not appreciated until this problem had been worked out.

Drag measurements have also been made in flight by means of a comb of small pitôt tubes which determine the difference in relative velocity between the air in the wake of the wing and the free air. It can also be applied in the compressed air tunnel, which will enable profile drag to be determined at Reynolds numbers of the order of those reached by fast modern aeroplanes.

Another problem has been to determine where on aeroplane wings the change from laminar to turbulent flow in the boundary layer takes place. As the drag associated with the turbulent boundary layer is considerably greater than that of the laminar layer, it is important to keep the transition point on the wing as far back as possible. It is suspected that protuberances in the surface of a wing near its leading edge may promote an early transition point and so increase the drag.

Modern high-speed machines have introduced other problems, particularly of stability. For example, directional stability is often unexpectedly good, although longitudinal stability is not so satisfactory. Further, increasing speed inevitably implies higher wing loading and thus introduces landing problems. The properties of flaps and other aids to stability, particularly when landing and taking off, have been studied, and work on gusts in the atmosphere is continuing.

Structural problems following upon the recent development of 'stressed skin' bodies and wings have shown that stabilizing members for flat, or slightly curved, sides of bodies need to be carefully studied for optimum efficiency. Tubular members are stronger for a given amount of material, but their use presents practical difficulties.

In aero-engine work, attention has been paid to the development of bi-fuel systems, which at the moment appear to be necessary with the use of 100 octane fuel. Direct fuel injection, supercharging, high boiling point liquids for cooling, spark ignition, and the compression ignition engine have been subjected to investigation in various details, but nothing revolutionary is proposed.

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* Aeronautical Research Committee. Report for the years 1935–36. Pp. 60+7 plates. (London: H.M. Stationery Office.) 4s. net.

The question of the size of sea-going aircraft has been studied in a general way, and the Committee expresses the opinion that no new scientific problem seems probable with flying boats of up to a hundred tons in weight.

The technical supplement to the report is subdivided into sections dealing with: aerodynamics, fluid motion, stability and control, oscillation, spinning, structures, elasticity and fatigue, alloys, engines, aircraft noise, seaplanes, meteorology, accidents, administration including (*a*) list of publications and (*b*) membership of sub-committees and panels.

"Discovery" Investigations*

DURING the years 1935 and 1936 three volumes have been published containing reports on material collected by the "Discovery" expeditions, on many subjects by various workers. Vol. 11 is devoted entirely to plankton, and forms an introduction to the study of the plankton of the Antarctic, embodying as it does, a detailed discussion of methods and their value, besides extensive accounts of the distribution and migrations of plant and animal plankton, pre-eminently important for the understanding of the natural history of the Blue, Fin, Sei and Humpback whales. It is noteworthy that the first instance of vertical migration of phytoplankton is here shown in certain species of *Coscinodiscus* which ascend during the daytime, the reverse of the usual animal migration. It is constantly seen in the "Discovery" reports that *Euphausia superba* appears to be a key animal with regard to the distribution of Antarctic plankton, forming directly the food of the Blue and the Fin whales, and indirectly influencing the plankton in a variety of ways. A consideration of the relationship between the distribution of the whales and that of the plankton, and between the zooplankton and the phytoplankton, has led to the recognition of certain general principles of pelagicecology.

The remarkable patchiness in distribution of many of the plankton animals is emphasized, and Prof. Hardy's hypothesis of animal exclusion, showing that the more important plankton animals avoid the areas of dense phytoplankton, is dwelt upon at length. In this connexion, the phosphate values are shown to be of extreme importance, and relative reduction in phosphate content appears to be a better index in studying the zoo-phytoplankton relationship than the phytoplankton itself, giving a measurement of phytoplankton over a little time in the past. The appearance of exclusion from regions of low phosphate (high phytoplankton) applies to animals belonging to widely different groups, and it is considered that if the distribution of the animals is being modified by the phytoplankton, this modification must be brought about by variations in the vertical migration in conjunction with differing water movements at different levels. All the animals which show the exclusion effects have marked vertical migrations. This first report is intended to form an introduction to pelagic ecology of the Antarctic seas. The plankton community is considered in relation to its hydrological background, and to the distribution of the Blue and Fin whales which feed upon the plankton and form the object of such an important fishery in these seas.

The second plankton report deals with the continuous plankton recorder invented by Prof. Hardy. This has now been much improved, and a full account is given of its construction, method of working and the advantages and limitations of the results obtained in its use. The third paper deals with observations on the uneven distribution of oceanic plankton, and describes records of plankton taken in the open ocean during the voyages of the R.R.S. *Discovery* and R.R.S. *William Scoresby* in the years 1925–27 with the original form of continuous plankton recorder. They were made with the view of studying the main fluctuations in the planktonic density along uninterrupted lines of observation. These lines varied from 23 miles to more than 100 miles in length, and were made in different oceanic regions from the tropical to the antarctic zone. The records demonstrate marked fluctuations in the distribution of the main planktonic groups of animals, no less marked in the tropics than in the antarctic zone. The existence of a rhythm in the distributional fluctuations is tentatively suggested, a rhythm which varies on different occasions.

Vol. 12 embodies a variety of subjects, the first being the coast fishes from the South Atlantic by J. R. Norman. The term 'coast fishes' includes not only the littoral forms, but also fishes that may occur at no great distance from the coasts in water down to two or three hundred fathoms deep, and that are not pelagic or bathypelagic. C. C. A. Monro continues his description of the polychaete worms (2), Dr. Th. Mortensen reports on the Echinoidea and Ophiuroidea, R. A. B. Ardley on the birds of the South Orkney Islands and Dr. R. Gurney begins his study of the decapod larvæ (Stenopidea, Amphionidæ and Phyllosoma).

In Vol. 13 A. Earland continues the Foraminifera (4), R. A. B. Ardley describes the R.R.S. *Discovery II*, its construction and design, accommodation for research, scientific equipment and laboratory methods, E. R. Gunther writes on oceanographical investigations in the Peru coastal current, and Dr. F. D. Ommaney contributes an extensive paper on the copepod *Rhincalanus gigas* (Brady) which is very important in Antarctic waters and is reported on fully in every aspect as a representative plankton animal in these regions.

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* *Discovery Reports.* Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol 11. The Plankton of the South Georgia Whaling Grounds and Adjacent Waters, 1926–1927. By A. C. Hardy and E. R. Gunther. Pp. iv+456. 50*s.* net. The Continuous Plankton Recorder. By A. C. Hardy. Pp. 457–510+4 plates. 9*s.* net. Observations on the Uneven Distribution of Oceanic Plankton. By A. C. Hardy. Pp. 511–538. 4*s.* net. Vol. 12. Coast Fishes, Part 1: The South Atlantic. By J. R. Norman. Pp. 58. 5*s.* net. Polychaete Worms, II. By C. C. A. Monro. Pp. 59–198. 18*s.* net. Echinoidea and Ophiuroidea. By Th. Mortensen. Pp. 199–348+9 plates. 27*s.* 6*d.* net. The Birds of the South Orkney Islands. By R. A. B. Ardley. Pp. 349–376+plates 10–12. 6*s.* net. Larvæ of Decapod Crustacea. By Dr. Robert Gurney. Pp. 377–440. 9*s.* net. Vol. 13. Foraminifera. Part 4: Additional Records from the Weddell Sea Sector from Material obtained by the S.Y. *Scotia*. By Arthur Earland. Pp. 76+3 plates. 12*s.* net. The Royal Research Ship *Discovery II*. By R. A. B. Ardley and Dr. N. A. Mackintosh. Pp. 77–106+plates 3–13. 9*s.* net. A Report on Oceanographical Investigations in the Peru Coastal Current. By E. R. Gunther. Pp. 107–276+plates 14–16. 26*s.* net. *Rhincalanus gigas* (Brady), a Copepod of the Southern Macroplankton. By Dr. F. D. Ommanney. Pp. 277–384. 15*s.* net. (Cambridge: At the University Press, 1935–1936.)

Science News a Century Ago

A Pigmy Cemetery

THE issue of the *Gentleman's Magazine* of August 1837 contains the following information: "A short distance from Coohocton, Ohio, U.S., a singular ancient burying-ground has lately been discovered. It is situated, says a writer in Silliman's Journal, on one of those elevated, gravelly alluvions, so common on the rivers of the West. From some remains of wood, still apparent in the earth around the bones, the bodies seem all to have been deposited in coffins; and what is still more curious, is the fact that the bodies buried here were generally not more than from three to four and a half feet in length. They are very numerous, and must have been tenants of a considerable city, or their numbers could not have been so great. A large number of graves have been opened, the inmates of which are all of this pigmy race. No metallic articles or utensils have yet been found to throw light on the period or the nation to which they belonged."

Monument to Gutenberg

THREE hundred and sixty-nine years after his death, a large statue in bronze of Gutenberg, the inventor of printing from movable type, was unveiled at his birthplace, Mainz, the inaugural proceedings extending over the three days, August 14–16, 1837. The statue was by the Danish sculptor Thorwaldsen, and it bears the inscription "Joannem Gensfleisch de Gutenberg Patricium Moguntinum, ære per totam Europam collato posuerunt cives 1837".

Hare and the Oxy-hydrogen Blow-pipe

ON August 14, 1837, Prof. Robert Hare (1781–1858) wrote from Philadelphia to Dalton, saying: "I beg leave, through you, to communicate to the British Association for the Advancement of Science, the fact that by an improvement in the method of constructing and supplying the hydro-oxygen blow-pipe, originally contrived by me in 1801, I have succeeded in fusing into a malleable mass, more than three-fourths of a pound of platina. In all, I fused more than two pounds fourteen ounces into four masses averaging, of course, nearly the weight above-mentioned." After further notes on the application of the blow-pipe, he said: "I need not say how much I regret that the Atlantic rolls now between myself and those respected and esteemed brethren in science, whom, this time last year, I had the honour and pleasure to meet and to greet at Bristol, and to whom I shall ever be grateful for their kind reception. How much would it gratify me, could I exhibit to them, and their enlightened visitors, that splendid concentration of heat and light which I have lately employed, by which a metal infusible in the air-furnace or forge is made as fluid as mercury, so as to be blown off in globules."

Gossage and the Alkali Industry

ON August 17, 1837, William Gossage secured a patent for "certain improvements in the processes of operation connected with the manufacture of alkalis from common salt"; a patent which anticipated the later and successful processes of Weldon, Mond and Chance for the recovery of manganese and sulphur. Gossage, who was born in 1799, had begun life in a chemist's shop at the age of twelve years; but by 1830 was a partner in a salt and alkali works at Stoke Prior, Worcestershire, and it was there that in 1836 he invented the 'Gossage' condensing tower for preventing the escape of hydrochloric acid gas, a "simple contrivance which saved from extinction a trade, the growth of which has contributed largely to the nation's prosperity". From Stoke Prior Gossage removed to Birmingham, establishing there a white lead works, and then to South Wales, where he engaged in copper smelting. In 1850 he settled at Widnes and became the largest soap manufacturer in the country. In 1861 he contributed a paper on "The History of Alkali Manufacture" to the Manchester meeting of the British Association. He died at Bowden, Cheshire, on April 9, 1877 (see "Some Founders of the Chemical Industry" by J. F. Allen).

The Magazine of Zoology and Botany

THE *Athenæum* in its issue of August 19, 1837, referring to the above journal, which was conducted by Sir William Jardine (1800–1874), P. J. Selby (1788–1867) and Dr. G. Johnson, said: "To the naturalist this periodical affords a most valuable repository of the current facts and opinions of writers upon all points relating to zoology and botany; and it quite answers to our notion of what such a production should be, if it be of great general utility. There are excellent original papers by Swainson, Henslow, Westwood and other men of high scientific reputation, independently of the authors whose names stand upon the title page; there is a brief and very honest indication of the most interesting matters treated of in other periodical works on natural history, well brought down to the period of publication; and to these are added well-written sensible critiques on many of the more important works upon this branch of knowledge. Moreover, and this is not to be overlooked—the botanical department is conducted with reference to modern views and with a commendable disregard of prejudices."

University Events

CAMBRIDGE.—Dr. J. H. Schulman, of Trinity Hall, has been appointed assistant director of research in colloid science.

D. J. Bauer, of Trinity College, has been elected to the Michael Foster studentship in physiology; the E. G. Fearnsides scholarship is awarded to A. M. Barry, of Pembroke College; the Wrenbury scholarship is awarded to P. T. Bauer, of Gonville and Caius College; the John Winbolt prize is awarded to D. W. Ginns, of Emmanuel College, for a dissertation on "The Mechanical Properties of some Metals and Alloys broken at Ultra High Speeds".

G. H. A. Wilson, master of Clare College, vice-chancellor of the University, has been appointed, in succession to the late Sir E. C. Hoskyns, to represent the University on Sept. 27–28 at the four-hundredth anniversary of the foundation of St. Mary's College in the University of St. Andrews. Dr. F. W. Aston and Dr. J. D. Cockcroft have been appointed to represent the University in Bologna on October 18 at the celebration of the bicentenary of the birth of Galvani. Prof. R. G. W. Norrish and Dr. J. D. Cockcroft have been appointed delegates from the University to a congress to be held at the Palais de la Découverte, Paris, on September 30–October 7.

Societies and Academies

Dublin

Royal Irish Academy, June 14

Joseph Algar and Isabella P. Carey: The synthesis of flavonols: oxidation of flavindogenides. The oxidation in acetone solution of the flavindogenide 3-benzylidene flavanone by means of acidified potassium permanganate appears to give 3-hydroxy-3-benzoyl flavanone (I). The latter forms a monoxine and a monacetate. Gentle hydrolysis of (I) gives flavonol and benzoic acid. Products similar in constitution to (I) are obtained by the oxidation of the following flavindogenides: 3-anisylidene flavanone; 3-piperonylidene flavanone; 3-benzylidene-3′.4′ methylenedioxy flavanone.

H. S. W. Massey: Creation of electron pairs by nuclear capture of neutrons. The probability of creation of electron pairs by the materialization of the energy freed in the capture of a neutron by a nucleus is calculated by a method not involving explicit introduction of light quanta.

C. B. Moffat: The mammals of Ireland. A catalogue is given of the species supposed to have any claim to inclusion in the fauna, with notes on the distribution and status of each. The list differs from Thompson's in including a much larger number of marine (chiefly oceanic) animals. Novelties among terrestrial mammals are few. They include, however, the Irish stoat (*Mustela hibernica*) and the Irish hare (*Lepus hibernicus*), both now marked as practically endemic. Three bats have been added to Thompson's list. There are also five new species of Rodentia. The pine-marten (*Martes martes*), is still known from ten counties; and the red deer (*Cervus elaphus scoticus*), though now confined as a strictly native species to a protected area in Kerry, has recently been shown to be living a perfectly wild life in a new home to which it has found its way among the Wicklow Mountains. The question of the admissibility of the wild cat (*Felis silvestris*) to a historic place in the Irish fauna is regarded as having been lately placed by Major Barrett-Hamilton in a new light.

Edinburgh

Royal Society, Edinburgh, July 5.

C. Forster-Cooper: The Middle Devonian fish fauna of Achanarras. This is the first section of a report on five seasons work in the flagstone quarry of Achanarras in Caithness and deals with the fishes of the genus *Dipterus*. Hitherto two forms, *Dipterus valenciennesi* and *D. platycephalus* have been considered as separate species differing in the structure of the scales and in the extent to which the skull is ossified. It is now shown that the difference is due to seasonal changes, as described by Westoll for the contemporary Crossopterygians, and that the two conditions alternate during the life of the fish, so that there is only one species represented and not two. The abundance of material has rendered possible a full restoration of the fish.

Flora Cochrane: A histological analysis of eye pigment development in *Drosophila pseudo-obscura*. A detailed examination of unstained histological sections of the eyes of wild type and various mutants of *D. pseudo-obscura* at various stages of development was made. This revealed that pigment in the form of granules appears in two types of pigment cells at two definite times during development and that genes which alter the colour of the eyes do so by affecting these granules in three distinct ways: (1) by suppressing the formation of all or part of the granules laid down in one or both types of pigment cells during either or both phases of development; (2) by altering the rate of granule development; (3) by causing a qualitative change in the granules.

A. R. Waterson and H. E. Quick: *Geonemertes dendyi* Dakin, a land nemertean in Wales. Since 1935, a land nemertean had been known from several localities near Swansea. The external and internal characters are described. Details are given of the habits, mode of feeding, and reproduction. The habitats are all damp places near streams or trees, and the nemerteans occur under stones and fallen branches. The sites seem to be free from contamination from exotic sources. Land nemerteans have not previously been found living under natural conditions in Europe.

R. S. Brown: The anatomy of *Ophelia cluthensis* McGuire. An account of a polychaete worm which seems to be fairly common in the sand just below high water neap tide, not only in the Clyde estuary, from where it was originally described, but also in other parts of Great Britain and northern Europe. The species was created by McGuire in 1935, but her description was very incomplete, and the present account gives much fuller details of its specific characters and also a discussion of its affinities with other members of the genus. The description of the anatomy includes an account of the lymphatic corpuscles, which in this genus consist of two types of cells: (i) small disk-shaped cells 15–20 μ in diameter, with radiating processes; and (ii) larger irregular cells, 40–150 μ in diameter, containing a dense central body usually in the form of a club. Reproductive cells are also found in the cœlomic fluid.

Paris

Academy of Sciences, June 14 (*C.R.*, 204, 1769–1848).

André Blondel: The search for short light signals by navigators. Discussion of the effects of the duration of the light signals from the physiological point of view.

Georges Charpy: The definition of the *nuance* of steels.

Jacques de Lapparent: The mineralogical nature of the clays of El Golea (Sahara).

Ottokar Borůvka: Multiplicative systems.

Michel Ghermanescu: A problem of Laguerre.

Richard Brauer: The multiplication of the characteristics of continued and semi-simple groups.

Kuntzmann: Multiform operations. Hypergroups.

M. Keldych and Michel Lavrentieff: The problem of Dirichlet.

P. Dupuis, H. Guillemet and André Martinot-Lagarde: The determination of the trajectories of the water particles in the flow through a centrifugal pump.

Jacques Valensi: A new method for the measurement of the delivery through a tube placed in a current of air of uniform velocity.

René Hirsch: The automatic stabilization of aeroplanes.

Pierre Auger, Paul Ehrenfest, jun., André Freon and Mme. Thérèse Grivet: The mechanism of the production of cosmic bundles. The experimental results described support the mechanism of production indicated by Bhabha and Heitler for the soft cosmic rays, that is, the group of electrons and photons present in the lower atmosphere.

Nicolas Perakis and Léandre Capatos : The thermomagnetic study of the complex compounds $(Ag_xCd_y4C_5H_5N)S_2O_8$.

Marcus Brutzcus : The heat of formation of hydrocarbons.

J. Timmermans and H. Bodson : The surface tension of water and that of heavy water. The variation of the surface tension of water with temperature shows an anomaly at 13° C.; with heavy water this appears at 17° C. This anomaly has not been detected by other workers on this subject.

G. Duch : The variations of the mechanochemical constants of the benzene hydrocarbons along the vaporization curve with origin at 74·5 cm. mercury.

Paul Bary and Jean Herbert : The transformation points of glasses.

Albert Tian and Edouard Gand : The ionic dissociation of the alkyl halides. Experimental evidence that, contrary to the view usually accepted, alcoholic iodides in aqueous solution behave as weak electrolytes.

Carsten Holtermann and Paul Laffitte : A new oxide of lead. The existence of Pb_7O_{11} has been proved from a study of the composition of the oxide as a function of the temperature under a pressure of 200 atmospheres. The only other oxides indicated on the curve are PbO_2 and the red Pb_3O_4.

Victor Auger and Mlle. Nina Ivanoff : The molybdenum blues. Amorphous colloidal molybdenum blue. The only molybdenum blue appears to be that described by Guichard with a formula Mo_8O_{17}, $7H_2O$. This blue is amorphous and colloidal.

Mme. Nathalie Demassieux and Louis Roger : A complex compound formed by lead iodide and lithium iodide in aqueous solution. This has the constitution PbI_2LiI, $4H_2O$.

Louis Hackspill and Georges Wolf : The thermal decomposition of the barium carbonates.

Michel Lesbre : Some halogen organic derivatives of lead.

André Meyer and Henri Drutel : Salts and complex compounds of 6-methyl- and 8-methyl-4-hydroxyquinaldines.

Gustave Vavon and Jean Bolle : The condensation of the benzene hydrocarbons with chlormethyl ether. Method of alkylation of aromatic nuclei.

André Demay : The role of static and dynamic phenomena in the genesis of the Cristallophyllian.

Jacques Flandrin : The attribution to the Oligocene of a part of the Nummulitic strata of the Kabylie of Djurdjura and its western prolongation (Algiers).

Jean Cuvillier : The presence of the marine Carboniferous in the ouadi Abou Darag (Arabian desert).

Edmond Rothé and Mme. Arlette Hée : Prospecting by the penetrating radiations in the trap and granite quarries of Raon-l'Etape.

Louis Bounoure : The fate of the germinal line in the russet frog after the action of ultra-violet rays on the lower pole of the egg.

Tchou-Su and Chen-Chao-Hsi : The spontaneous activation of the egg of the russet frog (*Carassius auratus*) in contact with fresh water.

Maurice Lemoigne, Pierre Monguillon and Robert Desveaux : The reduction of nitric acid to hydroxylamine by the higher plants. The role of ascorbic acid. The juice of lilac reduces nitrites to hydroxylamine and under the same experimental conditions ascorbic acid behaves similarly. Ascorbic acid is always present in the leaves and hence is probably the cause of the reduction of nitrite by the juice.

Michel A. Macheboeuf, Mmes. Georgette Lévy and Marguerite Faure : Researches on the chemical nature of the lipoid-fixing haptene of tubercle bacilli. Chemical study of the purified active fraction.

Pierre Lépine, Pierre Mollaret and Boris Kreis : The receptivity of man to the murin virus of lymphocytary choriomeningitis. The experimental reproduction of benign lymphocytary meningitis.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 251–294, May 15).

F. Zwicky : A new cluster of nebulæ in Pisces. During September and October last year, more than a hundred photographs with exposures of ten to thirty minutes were obtained at Mount Palomar with the new 18-inch Schmidt telescope of the Carnegie Institution of Washington ; characteristic features of the instrument are effective aperture 18 inches, focal ratio $F/2$, diameter of field used about 9·5°, limiting magnitude about 17·5. A large swarm of nebulæ in Pisces of large extension and asymmetrical shape suggesting rotation of the whole was observed.

R. A. Gortner and H. B. Bull : Electro-kinetics. (19) Interfacial energy and the molecular structure of organic compounds. (v) The electric moment of Al_2O_3 : benzene-nitrobenzene interface.

Jenny E. Rosenthal and Lloyd Motz : Application of a new mathematical method to vibration-rotation interaction.

K. G. Scott and S. F. Cook : Effect of radioactive phosphorus upon the blood of growing chicks. Growing White Leghorn chicks were given substantial doses of radioactive phosphorus (prepared by irradiation of red phosphorus) in the form of phosphoric acid. It gave rise to effects not obtained with X-rays. Lymphocytes, which are sensitive to X-radiation, were little affected ; polymorphonuclear leucocytes, which are not much affected by X-rays, were much decreased in number. These effects are attributed to deposition of the radioactive phosphorus in the bones, which allows bombardment with radiation of the bone marrow, the source of the polymorphonuclear leucocytes, whereas X-rays only reach the marrow with difficulty.

J. van Overbeek : Effect of the roots on the production of auxin by the coleoptile. If the root systems of *Avena* seedlings are removed, after 15–20 hours the auxin production is much reduced, causing deceased growth. When both roots and seed are removed, the plants do not 'regenerate' and their curvatures increase steadily. It is suggested that auxin itself and a precursor are present in the seed ; the latter is transported independently of the root system, and the former in the transpiration or root-pressure stream.

F. D. Murnaghan : The irreducible representations of the symmetric group.

G. A. Miller : Groups of order less than 2^m having $m - 1$ or $m - 2$ independent generators.

H. Whitney : Products in a complex.

A. Gleyzal : Linear orders.

C. H. Dowker : Hopf's theorem for non-compact spaces.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Structural Engineering Assistants in the Directorate of Fortifications and Works of the War Office—The Under-Secretary of State (C. 5), War Office, S.W.1 (August 16).

Assistant Lecturer in Pharmacy in the Technical College, Bradford—The Principal (August 28).

Technical Officer in the Signals Experimental Establishment, at Woolwich—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W.1 (August 27).

Lecturer in Physical Chemistry in the Battersea Polytechnic, London, S.W.11—The Principal (September 6).

Lecturer in Pathological Biochemistry in the University of *Glasgow—The Secretary of the Court (September 11).*

Director of Research of the Institute of Brewing—The Secretary of the Institute, Brewers' Hall, Addle Street, London, E.C.2 (October 15).

Civil Engineer in the Public Works Department of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Official Publications Received

Great Britain and Ireland

Report on the Phenological Observations in the British Isles from December 1935 to November 1936. (No. 46.) By Ivan D. Margary. (Quarterly Journal of the Royal Meteorological Society, No. 270, Vol. 63.) Pp. 219–275. (*London: Royal Meteorological Society.*) 3*s.* [97

Experimental Researches and Reports published by the Department of Glass Technology, the University, Sheffield. Vol. 19, 1936. Pp. iii+218+16 plates. (Sheffield: The University.) 7*s.* 6*d.* [97

Department of Scientific and Industrial Research. Forest Products Research Records, No. 18 (Mycology Series, No. 2): The Causes of Stain and Decay in Imported Timber. By K. St. G. Cartwright. Pp. ii+15+7 plates. (London: H.M. Stationery Office.) 6*d.* net. [127

Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, Ministry of Agriculture for Northern Ireland and Agricultural Research Council. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1934–1935. Pp. v+338. (London: H.M. Stationery Office.) 5*s.* net. [127

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1937. Pp. 68. (Aberdeen: North of Scotland College of Agriculture.) [147

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Cheshunt. Twenty-second Annual Report, 1936. Pp. 104. (Cheshunt: Nursery and Market Garden Industries' Development Society, Ltd.) [147

Make the Lake District a National Park. Pp. 16. (Ambleside: Friends of the Lake District.) [147

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1936. Vol. 71, Part 1: Acreage and Production of Crops, Number of Live Stock and of Agricultural Workers, and Output and Prices of Agricultural Produce in England and Wales. Pp. 109. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [157

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1735 (2184): Wind Tunnel Tests on Slotted Flaps on a Low Wing Monoplane; Flap Angle 0° to 90°. By D. L. Ellis and M. B. Morgan. Pp. 14. 2*s.* net. No. 1749 (2017): The Strength of Lugs. By Wm. D. Douglas. Pp. 21. 3*s.* net. No. 1755 (1976): Notes on Stubs for Seaplanes. By L. P. Coombes and D. W. Bottle. Pp. 32. 5*s.* net. No. 1756 (2584): The Distribution of Stress in Monocoque Wings. By Dr. H. F. Winny. Pp. 12. 2*s.* net. No. 1757 (2719): A General Method of Calculating the Effect of Axial Constraint on Torsion on Different Forms of Two-Spar, Skin-covered Wings. By A. E. Russell. Pp. 16. 2*s.* 6*d.* net. No. 1762 (2425): The R.A.E. Mark Va Torsiograph. By the Staff of the Engine Department, R.A.E. Pp. 14. 2*s.* 6*d.* net. No. 1763 (2539): A Note on Roughness. By Dr. S. Goldstein. Pp. 2. 6*d.* net. No. 1768 (2760): Some Experiments with Cascades of Aerofoils. By A. R. Collar. Pp. 7. 1*s.* 3*d.* net. No. 1772 (2747): Tests of R.A.F. 34 at Negative Incidences and of the Effect of Surface Roughness on R.A.F. 34 with Split Flap in the Compressed Air Tunnel. By D. H. Williams and A. F. Brown. Pp. 11. 2*s.* net. (London: H.M. Stationery Office.) [177

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1936 May 1—1937 April 30. Pp. 4. (Cambridge: Cambridge Observatory.) [197

National Central Library. 21st Annual Report of the Executive Committee, 1936–37. Pp. 70. (London: National Central Library.) [197

National Veterinary Medical Association of Great Britain and Ireland. The Veterinary Profession and its Organisation for the Control of Animal Diseases: Report of a Committee of Investigation of the National Veterinary Medical Association of Great Britain and Ireland. Pp. 113. (London: National Veterinary Medical Association.) [207

Papers from the Geological Department, Glasgow University. Vol. 19 (Octavo Papers of 1935–1937). (Glasgow University Publications, 43.) Pp. viii+17 papers. (Glasgow: Jackson, Son and Co., Ltd.) [217

Vocational Guidance. Pp. 20. (Exeter: University College of the South West of England.) [217

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Treub-Stichting. Eerste Verslag 1936. Pp. 29. (Buitenzorg: Archipel Drukkerij.) [97

Indian Lac Research Institute. Annual Report for the Financial Year 1936–37. Pp. 37. (Namkum: Indian Lac Research Institute.) [97

Journal of the Indian Institute of Science, Vol. 19A, Part 8: Studies in the Proteins of Indian Foodstuffs. Part 10: *In vitro* Digestions of the Globulins from Aconite Bean (*P. aconitifolius*, *Jacq.*) and Bengal Gram (*Cicer arietinium*, Linn.). By Kamala Bhagvat. Pp. 67–78. (Bangalore: Indian Institute of Science.) 10 annas. [127

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 104: Investigations on the Occurrence and Inheritance of the Grass Clump Character in Crosses between Varieties of *Triticum vulgare* (Vill.). By J. R. A. McMillan. Pp. 68+8 plates. (Melbourne: Government Printer.) [127

India Meteorological Department. Meteorological Organisation for Airmen, 1937. Pp. iii+62. (Delhi: Manager of Publications.) 1.6 rupees; 2*s.* 3*d.* [127

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1933. Pp. xiv+219. (Cairo: Government Press.) P.T. 40. [127

Cawthron Institute. Annual Report, 1936. Pp. 18. Cawthron Lecture, 1936: Links in the New Zealand Flora with the Remote Past. By the Rev. J. E. Holloway. Pp. 28+2 plates. (Nelson, N.Z.: Cawthron Institute.) [127

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Royal Observatory, Hong Kong. Meteorological Results, 1936. Prepared under the direction of C. W. Jeffries. Pp. iv+146+18. 3 dollars. Report of the Director of the Royal Observatory, Hong Kong for the Year 1936. Pp. 8. (Hong Kong: Royal Observatory.) [127

Smithsonian Miscellaneous Collections. Vol. 96, No. 2: Wave Lengths of Radiation in the Visible Spectrum promoting the Germination of Light-sensitive Lettuce Seed. By Lewis H. Flint and E. D. McAlister. (Publication 3414.) Pp. 8+1 plate. (Washington, D.C.: Smithsonian Institution.) [127

Colony of Mauritius. Annual Report of the Board of Directors of the Mauritius Institute for 1935. Pp. 16. Mauritius Institute Bulletin, Vol. 1, Part 1: Catalogue of the Flowering Plants in the Herbarium. Revised edition. By Dr. R. E. Vaughan. Pp. 120. 2.50 rupees. (Port Louis: Government Printer.) [127

U.S. Department of Agriculture. Miscellaneous Publication No. 270: Post-Mortem Examinations of Wild Birds and Mammals. By J. E. Shillinger and William Rush. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents. [127

Canada: *Department of Mines and Resources, Mines and Geology* Branch: Bureau of Mines. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), January to June 1936. (No. 774.) Pp. iii+186. (Ottawa: King's Printer.) [127

Proceedings of the Fourth International Locust Conference, Cairo, April 22, 1936. Pp. 96. (Cairo: Government Press.) [137

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 89. Notes on Fishes from the Gulf Stream and the New Jersey Coast. By Henry W. Fowler. Pp. 297–308. A Collection of Haytian Fishes obtained by Mr. Stanley Woodward. By Henry W. Fowler. Pp. 309–315. A Second Study of New and Little-known Madagascar Grouse-Locusts (Orthoptera, Acrididæ, Acrydiinæ) with a Key to the Species of Thymochares. By James A. G. Rehn. Pp. 317–329. (Philadelphia: Academy of Natural Sciences.) [137

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 152: The Moment of the Fluid Pressure acting on a Flat Plate in a Semi-infinite Stream bounded by a Plane Wall. 1: Case of Lower Boundary (the Ground Effect). By Susumu Tomotika and Isao Imai. Pp. 421–471. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 60 sen. [157

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction by Prof. Joubin. No. 17. Pp. 52. (Copenhague: Andr. Fred. Høst et fils.) 4.00 kr. [157

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Government of India: Industrial Research Bureau. Report for the Year 1936–37. Pp. iv+25. (Delhi: Manager of Publications.) 14 annas; 1*s.* 6*d.* [197

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Summary Proceedings of the Thirty-third Meeting of the Indian Central Cotton Committee, Bombay, held on the 17th and 18th August 1936. Pp. 96. (Bombay: Indian Central Cotton Committee.) 1 rupee. [197

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Proceedings of the United States National Museum. Vol. 84, No. 3015: Mexican Fossil Echini. By Robert Tracy Jackson. Pp. 227–237+plates 12–15. (Washington, D.C.: Government Printing Office.) [217

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Milk Supply and National Health

A FEATURE of the present-day interest in nutrition is the number of unofficial organizations which have sprung up with the object, by propaganda and other means, of directing attention to what is naturally and properly considered to be a matter of immediate public concern, and of stimulating the Government to take action on recommendations regarding nutritional needs which have been made by expert committees of the League of Nations, the Ministry of Health and other authoritative bodies.

Active among these organizations is the Children's Minimum Council—a non-party body the aim of which is to secure that no child shall, by reason of the poverty of its parents, be deprived of at least the minimum of food and other requirements necessary for full health. Undeniably, widespread damage is caused to our national health by malnutrition during pregnancy and lactation and in the early years of childhood. Undeniably, also, inadequate family means among a large section of our population is the chief contributory factor to the existence of this state of affairs. Such is proved by the recent surveys of Orr, M'Gonigle, Rowntree and others.

There is much that is still controversial regarding the right nutrition of our people; but for those who seek an early improvement in existing conditions there is one guiding principle which may be followed without fear of contradiction or misdirection. It is the indisputable value of milk for nursing mothers and children.

In a recent memorandum on "Milk for Mothers and Children under Five", the Children's Minimum Council stresses the case for cheap milk. Expert Government committees have now unanimously declared that the desirable daily amount of milk for children is from one to two pints, for expectant and nursing mothers about two pints, and for other adult members of the community half a pint. At the present average prices, a family in which there are three children taking, say, one and a half pints a day each, an expectant mother taking two pints, and a father taking half a pint, would have an average milk bill of 13*s.* 3*d.* a week. Such an expenditure is, of course, quite beyond the means of working-class families with dependent children.

Consumption of milk in working-class households is far below the amounts regarded as desirable. Statistics from all over the country show how consumption drops with falling income and with an increasing number of children in the household. Many children get little or no fresh milk. For example, a survey of more than thirteen thousand school children in the Glasgow area showed that 57·7 per cent did not drink milk at all.

The proposal of the Children's Minimum Council is that milk should be made available at 1½*d.* a pint for expectant and nursing mothers and children under school age in families covered by National Health Insurance or of equivalent economic status. Both producers and distributors should be asked to make some concession in their prices for milk supplied under the scheme, and whatever subsidy is thereafter needed to bring the price down to 1½*d.* a pint should be paid by the national Exchequer. It is estimated that there are in Great Britain about three and a half million expectant and nursing mothers and children under five. The Council argues that a yearly Government subsidy of just over one and a half million pounds would suffice to provide for an annual distribution of eighty million gallons of cheap milk among that number. This is on the assumption that their orders for the milk would average half a pint per head per day.

Any scheme which attempts to break down the price barrier preventing an adequate consumption of milk by those who most stand in need of it deserves our attention. Nevertheless, however laudable in itself, this new scheme is but another expedient (of which there are already three in existence) to remedy an evil the root cause of which lies much deeper than the mere inability of people to pay for milk. Various State-aided schemes for the provision of cheap milk to mothers and children are already in operation under the Public Health Act of 1936, the Education Act of 1921 and the Milk Act of 1934. Admittedly there are defects and anomalies in these schemes; but another will only bring confusion to an already complicated position and further increase the administrative difficulties of our already overburdened public health services.

The case requires more drastic handling, and demands a fundamental change in the whole statutory position which at present governs the production and marketing of milk. In the past, the Government has tended to serve the economic interests of producers at the expense of the health interests of consumers. While no one will deny a fair return to the producer, it is out of all proportion that the interests of 175,000 producers should come before those of the ten million children on whose health the future of the country depends. The time has come when the Government must take a comprehensive view, and, without fear or favour, design a unified milk policy to meet the needs of the whole community.

Genetics and Plant Breeding in the U.S.S.R.

THE fourth session of the Lenin Academy of Agricultural Sciences, held in Moscow at the end of 1936, witnessed a determined campaign against genetics as the main basis of scientific plant breeding[1]. It is only now, however, that detailed reports of some of the speeches made at the session are available, while further light is thrown upon the controversy by recent Soviet publications.

The attack was opened by a group of plant-breeding experts headed by T. D. Lysenko, a member of the Odessa Institute for Selection and Genetics. The main ideas of Lysenko do not appear to have been published in a scientific form, but they are expressed in a popular pamphlet[2] and in his speech at the session of the Academy of Agricultural Sciences[3]. They are based on no lesser, and no later, authority than that of Charles Darwin, whose teachings according to Lysenko "were unable to blossom out properly in bourgeois countries. The best Darwinists in capitalistic countries, as for example Burbank in America, as well as our revolutionaries-biologists K. A. Timiriazev and I. V. Michurin in the Czar's Russia, were lone fighters." The works and theories of de Vries, Johannsen, Bateson, Morgan, are dismissed on the strength of a few quotations from their writings, suggesting their critical attitude to some of Darwin's ideas, all of which are held by Lysenko to be the last word in biology.

The actual controversy is centred around two points of practical plant breeding. One concerns the problem of crossing and selection of self-fertilizing pure line plants. According to Lysenko, pure lines if cultivated for a long time are liable to degeneration. This can be prevented, and the line even improved, by artificial cross-fertilization within the variety. "Small field experiments" made at Odessa with some varieties of wheat have shown an increase in the yield from cross-fertilized seeds, and this was taken to be sufficient to consider the method ready for immediate introduction into practice. About 10,000 farmers on 2,000 collective farms were instructed to sterilize wheat plants by cutting stamens to prevent self-fertilization. As a result, 500–1,000 gm. of cross-fertilized seeds were obtained on each farm. "If it happens that the seeds from intra-varietal crossing should be of higher quality, should produce plants with greater yield . . . , there will be no obstacle to a rapid transformation of a kilogram of seeds on each farm into tens of tons". Since Lysenko is also practically certain (although without apparent data) that the improved plants will be more resistant to winter frosts, he urged the Academy to pay serious attention to the question of the immediate necessity of introducing the method of cross-fertilization on "at least 50–70 thousands of collective farms".

It does not appear to be safe to criticize such enthusiastic plans, containing a promise of enormous and immediate progress towards the fulfilment of Stalin's recent order for increased agricultural production. N. I. Vavilov[4], in his reply to Lysenko, merely pointed out that many pure varieties of wheat, barley, etc., have existed without any "degeneration" for centuries, and there is no need to seek to improve them by intra-varietal cross-fertilization. Even if such crossing should produce an improvement (due to heterosis), it remains to be shown that the improvement will be lasting, since usually heterosis disappears in a few generations. G. Meister[5], who summed up the discussion, very cautiously suggested that it would be premature to develop extensive practical programmes while the method is still being studied experimentally.

While this first point of the discussion was mainly concerned with a practical problem, the second presented a clash between two almost diametrically opposed fundamental conceptions of biology. The discussion developed round Lysenko's forceful statements that the external conditions under which a plant develops have a profound effect not only on the somatic, but also on the sex cells. Therefore, responses of the constitution of an individual plant to its environmental conditions are inheritable, contrary to the views of "bourgeois" geneticists. This theory is based on three incomplete years of experiments with the vernalization of winter wheat and rye; none of these experiments was carried beyond the fourth generation and the results do not appear fully conclusive[2,3]. Nevertheless, Lysenko claims that the possibility of "changing the nature of plants" has been definitely proved, and promises in the near future to develop new varieties of winter wheat with increased cold-hardiness, of cotton requiring less heat for its growth, etc.

On the face of it, Lysenko's theory is nothing but Lamarckism in its simplest form, and this was pointed out by several speakers. Such accusations of being unfaithful to Darwinism appear, under Soviet conditions, to be tantamount to charges of high treason. Lysenko, therefore, had to insist that his theory is nothing but a development of most orthodox Darwinian views. His defence is worth quoting, since it provides a typical example of methods of discussion adopted by some Soviet scientific investigators: ". . . no work can possibly produce positive results if it starts on the basis of Lamarckism. If, by suitable breeding of plants, we have already succeeded in altering their hereditary nature in the desired direction, this alone proved that we are not Lamarckists. . . ." Lysenko insists further that he is not against the science of genetics, but "genetics as one of the most important sections of agro-biological science must be . . . remade in our Soviet way, without accepting many anti-Darwinian tendencies of fundamental genetic conceptions".

The problem of the inheritance of acquired characters has such an extensive literature and is still so far from its solution, that recent Russian work on vernalization and allied phenomena should be regarded merely as providing additional experimental data on the subject. Some of the results may be suggestive, but they certainly do not in any way justify Lysenko's assertions that the secret of "changing the nature of plants" is now discovered. These assertions would not be worth recording, were it not for the fact that they led, not to a healthy discussion, but to unscrupulous attacks on the large Russian school of geneticists deservedly appreciated by biologists in other countries. It is true that Lysenko and his colleagues veiled their attacks, for example, on Vavilov, by professing profound respect for his work; but at the same time they lost no opportunity for stressing what they consider to be anti-Darwinian tendencies in his ideas. In a country where Darwinism—as interpreted by Engels and Lenin—constitutes the ideological basis of official philosophy, arguments of this kind savour of denouncing an enemy of the State. Some practical effects of these accusations were pointed out by Meister[5], who said that certain Soviet editors already refuse to publish articles dealing with genetics, which appear to them bordering on counter-revolution. It is also perhaps not a mere coincidence that the International Genetical Congress, which should have been held in Moscow this summer, has been postponed.

On the whole, the discussions, which must have stirred very deeply all biological workers in the Soviet Union, appear to be of very limited theoretical interest. They are, however, of outstanding significance in revealing the atmosphere in which scientific investigators in totalitarian countries have to live and work.

[1] NATURE, 139, 185 (Jan. 30, 1937).

[2] "Changing the Nature of Plants" (in Russian). Pp. 46+10 figs. (Moscow, 1937.)

[3] *Pod Znamenem Marxisma*, 2, 96–118 (1937).

[4] *Front Nauki i Techniki*, 2, 54–61 (1937).

[5] *Front Nauki i Techniki*, 2, 42–50 (1937).

Willard Gibbs and his Work

A Commentary on the Scientific Writings of J. Willard Gibbs, Ph.D., LL.D., formerly Professor of Mathematical Physics in Yale University.

Vol. I: Thermodynamics; dealing with the Contents of Volume One of the Collected Works. Edited by Prof. F. G. Donnan and Prof. Arthur Haas. Pp. xxiii + 742. Vol. 2: Theoretical Physics; dealing with the Contents of Volume Two of the Collected Works. Edited by Prof. Arthur Haas. Pp. xx + 605. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1936.) 45*s*. net.

IT is now sixty-four years since Willard Gibbs published in the *Transactions of the Connecticut Academy* the first of his classical papers on thermodynamic theory, and thirty-five since the publication of his "Elementary Principles in Statistical Mechanics".

Almost contemporaneous with the last-mentioned event was the introduction by Planck of the 'quantum of action', which was destined to revolutionize atomic and molecular physics. It is not inappropriate, now that the new theories have largely taken shape, that Gibbs's work should be rediscussed with the view of examining how much of it retains its validity in the light of modern physics.

The two volumes under review have been prepared under the auspices of Yale University, where Willard Gibbs was professor. They consist of a symposium, to which a number of distinguished workers have contributed, with the double object, first of doing honour to the memory of Willard Gibbs, secondly of providing a commentary to guide the reader of his collected works. This last indeed is very necessary, for Gibbs's own treatment is frequently far from easy to follow and, apart from this, both nomenclature and methods differ appreciably from modern practice.

In view of the above intention, Gibbs's notation has been adhered to, and the commentary begins with a very brief but very valuable note on symbols and nomenclature by Prof. F. G. Donnan, for which anyone who has lost himself in the maze of 'free energies', 'available energies' and 'thermodynamic potentials', as envisaged by various authors, will be indeed thankful.

The first volume, which is under the general editorship of Prof. Donnan and Prof. Arthur Haas, deals with the subject-matter of vol. 1 of Gibbs's Collected Works, that is, mainly with his first three classical papers.

The general theory of thermodynamics as expounded by Gibbs forms the theme of quite a number of the contributions, in particular articles (*D*) "The General Thermodynamic System of Gibbs", by J. A. V. Butler, (*G*) "The Phase Rule and Heterogeneous Equilibrium" by G. W. Morey, and (*J*) "The Fundamental Equations of Ideal Gases and Gas Mixtures" by F. G. Keyes. Prof. E. A. Milne contributes an article on the thermodynamic functions and criteria of equilibrium, and Prof. Schreinemakers one on graphical methods using the free energy function. To the same group belongs the leading article (*N*) of the second volume, "The Thermodynamic Principles as Extended and Perfected by Gibbs" by Prof. Arthur Haas.

Special subjects such as osmotic equilibrium (E. A. Guggenheim), the thermodynamics of elasticity and interface phenomena and capillarity (James Rice) are dealt with in separate articles.

There is naturally a good deal of overlap; thus Gibbs's paradox in connexion with the diffusion of two gases into one another is described and discussed by both Dr. Butler and Prof. Haas, and this is not an isolated case. On the whole, this overlapping is rather an advantage than otherwise; the differences of presentation are often complementary and illuminating.

It is, however, to be regretted that, although Gibbs's famous criteria for equilibrium are explained at least three times, namely, by Butler and by Milne in vol. 1 and by Haas in vol. 2, there appears to be nowhere an adequate discussion of their validity, at any rate in the most difficult case, that of unstable equilibrium. Butler alone attempts to deal with this case, and he follows Gibbs's own lines; but unfortunately Gibbs is here entirely unconvincing. In view of the importance of these criteria a careful and critical examination would not have been out of place.

The second volume, which deals nominally with vol. 2 of the Collected Works, contains two articles, (*N*) and (*O*), devoted to classical thermodynamics. The first has already been mentioned above. The other, by Prof. Epstein, deals with the subsequent continuation by Nernst and others of Gibbs's purely thermodynamical work.

Other articles by Leigh Page, E. B. Wilson and Arthur Haas concern Gibbs's contributions to the theory of light, to vector analysis and multiple algebra and to dynamics respectively.

The bulk of this volume is devoted to Gibbs's work on statistical mechanics, most of it being from the pen of Prof. Haas; but the last two articles but one, by Epstein, contain a very instructive criticism and appreciation of Gibbs's work in the light of recent theories. Haas himself, at the end of article (*R*), has dealt with the derivation of the ideas of wave-mechanics from Gibbs's conception of phase-space, and the whole of this section is highly suggestive and deserves the most attentive reading.

Admirable as the "commentary" is in general, one cannot help feeling occasionally that it is itself at times in need of a commentator to clear away obscurities.

This is noticeable, for example, in the treatment of elastic solids in vol. 1 (art. *K*), which is far more difficult to follow than the usual expositions of the analysis of stress and strain in treatises on elastic theory. In one place (p. 445) the writer of the article uses as "more convenient" a set of strain-variables which do not form a tensor and which, for that reason, would be highly inconvenient for use in an isotropic solid.

Another example may be taken from vol. 2, pp. 192–203, where a number of difficulties occur. Thus (*a*) on p. 192, the reader is not told why the vanishing of $\int Dv_n df$ must involve $\frac{\partial D}{\partial t} = 0$; (*b*) on pp. 196–97, the vital assumption by Gibbs of the form $\exp\left\{(\psi - \epsilon)/\Theta\right\}$ for P is described as "plausible"; but there are an infinity of forms for P which will ensure the convergence of the integral $\int \ldots \int P\epsilon dq_1 \ldots dp_n$, and the reader might well expect to be told why one "plausible" form is preferred above all others; (*c*) on p. 198, the statement that $\int \ldots \int dq_1 \ldots dq_n = f(V)$ is not true unless the q's are Cartesian co-ordinates, in which case f can only be a power, as correctly stated on p. 200; (*d*) on p. 202, no explanation is given of the absence of a term in $d\Theta$ in equations (56) and (60), although $\bar{\epsilon}$ as defined by (55) appears to be a function of Θ.

Taken as a whole, however, the commentary forms a most welcome addition to the literature of a difficult subject, and will be not only a worthy monument to one of the greatest mathematical physicists of the nineteenth century but also an excellent exposition of his ideas by some of the greatest experts in the subject at the present time. The work involved has clearly been enormous, and the editors and their collaborators have well deserved the congratulations which they undoubtedly will receive.

It is perhaps still too early, in the present fluid condition of physical science, to estimate Willard Gibbs's position in the development of theoretical physics and chemistry. Those who hope for such an estimate from these two volumes are likely to be disappointed. We are given a very full and very instructive paraphrase of Gibbs's work, and deductions from it. We are shown its connexions with contemporary and subsequent developments; but no real attempt is made to apply critical analysis to the work itself and to discriminate between the best and (at any rate) the second-best. Yet that in such a mass of new methods and results weaknesses or indeed failures must have occurred seems inevitable; even Newton was not exempt. A commentary written in a more critical spirit would certainly have done Gibbs's memory no harm and would undoubtedly have helped towards a better understanding of his work.

Even on the question of the relative value and permanence of the thermodynamics and the statistical mechanics—which represent widely different scientific philosophies—we are left in doubt. Possibly this is the unavoidable result of the symposium method, and of a natural diffidence on the part of individual contributors. But the reader puts down the book with the feeling that the final summing-up about Gibbs has yet to be written.

L. N. G. F.

The Peasant Farmers of Ireland

The Irish Countryman:
an Anthropological Study. By Dr. Conrad M. Arensberg. Pp. xi + 216. (London: Macmillan and Co., Ltd., 1937.) 10*s*. 6*d*. net.

DR. ARENSBERG'S anthropological study of the peasant-farmer population of western Ireland will be held to confirm their views by those who believe that much of the primitive survives in the modern Irishman. It is this element in his make-up, they would maintain, which has persisted, certainly from pre-conquest, and possibly from prehistoric, days, and lies at the root of a misunderstanding between governors and governed, dating back so far as the twelfth century and distorting, as it would appear to the Irish, the vision of Giraldus Cambrensis.

As a social anthropologist, Dr. Arensberg's approach to the culture of the west is that of the analyst of patterns of behaviour. He shows how the whole social nexus of the peasant-farmer class, with which he is dealing, nucleates in the land, that is, in the farm holding, not merely as a matter of the internal economy of a single unitary organization, but also as one among a number of similar organizations, with mutual accommodations, perhaps even obligations, in co-operation at times of pressure in their agricultural functions, and a conditioned relation to the traders of the nearest or central town. The all-pervading influence of the land, and the character of the social economy to which it gives rise, can be discerned most clearly, perhaps, in such diverse matters as the system of passing the control of the farm to one of the sons at the oncoming of age—though not necessarily of senility—match-making, the late age for marriage, and the system of retail purchase and credit, which are not a question of finance simply, but depend on kinship, social relation, or other economically extraneous considerations, rather than price and quality.

It is interesting to translate Dr. Arensberg's study of patterns and nuclei of behaviour into the more formal and familiar terminology of traditional methods of observation. The primitive character of this community, with which he is concerned, immediately becomes more clearly apparent. It is then evident that in the peasant-farmer population we are dealing with a community in which the unit is the family, supplemented by the extended family and the kinship organization. It has its age classes, each with its club-house, and headed by an assembly of elders, who regulate the affairs of the community and are the repository of tradition. Marriage follows on or accompanies initiation into manhood, which goes with the accession of responsibility on the farm. Hence the late age of marriage. It follows also from this peculiar economy that the town is literally the market town, a meeting place for the exchange of produce, which functionally has no independent existence. There is also a place for primitive religious belief, as over and above the orthodox creed, there is an all-pervading animism, the belief in "they", the fairies, or *sidhe*.

It is perhaps not remarkable that a mentality in which these elements of behaviour are so deeply engrained as to have survived for centuries should have been incompatible with a system of landlordism.

Chemistry for Everyman

Chemistry, Matter and Life
By Dr. Stephen Miall and Laurence Mackenzie Miall. Pp. x + 296 + 8 plates. (London: Edward Arnold and Co., 1937.) 7*s*. 6*d*. net.

THE popularization of chemical science is a notable feature of the twentieth century, and the appearance of the volume under consideration is welcome evidence that the demand for books which give a readable and accurate account of the achievements of scientific chemists still continues. In looking back over the past thirty years or so, it is of interest to note how the methods have altered by which authors have sought to capture the interest of their readers. Formerly, it seems to have been considered necessary to emphasize in the titles chosen the wonder, the romance or the mystery of chemistry, and in the text the reader was constantly being aroused to amazement and wonder. Each sentence, almost, ended in an exclamation mark, and it was sought to hold the attention of the reader by means of slogans and the devices of the advertising agent.

Nowadays, these methods of exposition have fortunately almost disappeared, and the intelligent and educated public is now supplied with books, such as the one before us, in which the facts and theories of chemistry are presented clearly and soberly and left to make their own impression. One cannot but welcome the present work, in which the authors "have tried to describe in language that any educated person can understand some of the main principles of chemistry, the nature of matter, and some of the chemical changes that take place in living plants and animals". The qualifications of the senior author, at least, are a sufficient guarantee that the attempt has not been made in vain.

Within the compass of less than three hundred pages, and in a succession of twenty-seven chapters, the authors have considered briefly, sometimes too briefly, the general aspects of much of present-day chemistry. In the first eighteen chapters we have presented to us an account of modern views regarding the constitution of matter, of the arrangement of atoms and molecules in crystals, of the spontaneous transformations which atoms are undergoing in radioactive substances and of the similar transmutations which can now be brought about artificially. The discussion of these and other topics leads on to the consideration of some of the substances which are formed in the bodies of plants and animals and of the chemical processes which take place in the living organism. These closing chapters are necessarily less easy to read and understand than the earlier ones, yet the authors have succeeded in giving to the general reader an idea of the truly extraordinary work which has been achieved by chemists in unravelling the molecular constitution of the complex compounds which build up the structure of plants and animals, which control the health of the animal organism and which give to plants their marvellous colours.

The book can be recommended to all who wish to obtain some knowledge of what the science of chemistry means. It is readable and reliable, and is well illustrated by diagrams and plates; but why, one may ask, should there be given on the jacket a picture of an alchemist in his laboratory rather than a picture of, say, Ramsay or of Robinson? Is it thought that the fading glamour of alchemy, of which there is no mention in the text, may act as a lure? ALEX. FINDLAY.

Technological History

The Collected Papers of Rhys Jenkins, M.I.Mech.E.

comprising Articles in the Professional and Technical Press mainly prior to 1920 and a Catalogue of other Published Work. (Links in the History of Engineering and Technology from Tudor Times.) Pp. x+247+8 plates. (London: Newcomen Society, 1936.) 21*s*.

TWO things strike one at the first glance into this handsome volume: first, the wide range of Mr. Jenkins's researches and his large output; secondly, the reflected glory which shines on the Newcomen Society through having published the volume, apart from the fact that it is "a token of the affectionate regard in which he is held by members of the Society".

Closer examination of the work reveals that it is nearly all based on hitherto unpublished material obtained from the most out-of-the-way sources, indicative not only of keen research, but also of a flair for knowing where to look. Not only so, but also Mr. Jenkins has visited the localities where the industries he describes have been carried out; he has in some cases located their sites and he has exhausted the traditional sources of information locally. What is so refreshing about the author is that he brings to the sifting of the evidence and the weighing of facts a critical inquirer's mind. He examines the stories which have hitherto served as history, and extracts from them whatever modicum of truth they may contain. His papers may be studied as models of historical research, and he himself is rightly regarded as the doyen of students in the field of engineering and industrial history.

The papers have been gathered from many sources, but are reprinted substantially as they appeared; where new matter has come to light after the publication of any particular paper, this matter has been dealt with by Mr. Jenkins in an appendix.

In general, the papers represent Mr. Jenkins's activities prior to the founding of the Newcomen Society by himself and others in 1920; since that date, most of his contributions have found their way into the *Transactions* of that Society. Taken together, they thus form a corpus of all his work up to date.

Turning to the subject-matter in detail, it may be conveniently classified under these headings: mechanical technology; steam engineering and foundry work; hydraulic and sanitary engineering; industrial and economic history. In the space at disposal, attention may be directed to a few of the papers. Foremost among them are those which elucidate the history of the steam engine and the work of Sir Samuel Morland, Thomas Savery, Thomas Newcomen and Henry Beighton. It may be said without hesitation that Mr. Jenkins's researches in this direction have added more to our knowledge than the whole of that available previous to his time. Another subject treated in a masterly manner is the history of paper-making in England in 1495–1788; even the site of the mill of John Tate, the first English paper maker, had been lost. The history of an industry—that of tin-plates—that has been associated with Mr. Jenkins's native county—is the subject of what will undoubtedly remain a classic memoir.

Sufficient perhaps has been said to indicate the interest of these "Collected Papers". To conclude the volume there are complete lists of the published works of Mr. Jenkins, authorities quoted, and a really good index. This is, we believe, the first time that such a volume has been published by an engineering society in Great Britain, and the Society, the editor, Mr. E. W. Hulme, and the printers are to be congratulated on the results of their combined efforts. No student of industrial history can afford to overlook this remarkable volume.

Vitamins in Theory and Practice

By Dr. Leslie H. Harris. Pp. xix + 242. (Cambridge: At the University Press, 1937.) 8*s.* 6*d.* net.

THE first edition of Dr. Harris's book was published at the end of 1935 and reviewed in NATURE in the spring of 1936 (137, 868). Its deserved success is doubtless one reason why a new edition has been needed so soon; another is the speed with which advances in vitamin chemistry have been made during the last eighteen months, a speed unusual even in this exceptionally fast-moving branch of biochemistry.

During that period the exact structures of aneurin chloride (vitamin B$_1$) and of lactoflavin (part of the 'vitamin B$_2$ complex') have been made known, and both have been completely synthesized. The detailed structures of two antirachitic vitamins, calciferol (vitamin D$_2$) and the 'natural' vitamin of halibut and tunny liver oils (vitamin D$_3$) have been worked out and a generally accepted formula has been proposed for each; the latter has been prepared from inactive substances, both 'natural' and of laboratory origin, and it has also been obtained crystalline, though too recently for the fact to be recorded by Dr. Harris. The claim by Evans to have isolated vitamin E, which he calls "tocopherol", is accepted by Dr. Harris, but he would not find that all workers in this field agree with him on the matter.

Apart from expanding his book to include these items of new discovery, the author has made few additions. He might, perhaps, with advantage have included reference to the more recent work on the treatment of habitual abortion with wheat-germ oil or extracts made from it (Shute, Watson, Currie), especially as this work confirms the original observations of Vogt-Möller, recorded in this edition in words identical with those used in the first. But Dr. Harris is perhaps wise in a book of this nature, intended for lay consumption, to err on the side of caution.

A. L. BACHARACH.

Thirty Years of Nature Photography:

a Personal Record of Two Observers. By Seton Gordon. Pp. xi + 100 + 108. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1936.) 21*s.* net.

THE author has been photographing birds and their nests since 1903, inspired originally by the books of Richard Kearton. His wife had also observed and photographed sea and moorland birds, and after marriage the two enthusiasts helped each other in this fascinating pursuit. The beautiful plates of this book are the result of their collaboration, the letterpress explaining the methods used, with particular emphasis on the necessity for a 'hide', and for two observers to use it.

There are photographs of sea birds, moorland birds, a few of seal and deer, and two remarkable pictures of crested tits. The account of the taking of these photographs shows that considerable physical fortitude, besides infinite skill and patience, went to the making of a book which admits the reader to the intimate family life of these untamed creatures.

Most of the photography was done with a large camera from a hide, a hand camera being used for sea birds only. The photography of the latter is comparatively simple as they are not very shy, the main difficulty being the inaccessibility of their haunts. But photographs such as those of the golden eagles caressing each other above their eaglet, feeding and sheltering the eaglet, and of the hooded crow with her nestling are wonderful achievements, alike in photographic skill and bird study. Regarded pictorially, the 'close-ups' are better than such pictures as "Stags Crossing a River", where the lens is too good for the picture, the deep focus giving no sense of recession.

The author comments on the difficulties found in enforcing the Wild Birds Protection Act. Books such as this must, we hope, turn a reader's thoughts to study of a bird as a lovely sentient being, rather than as a stuffed corpse or a blown egg.

Flora of Jamaica:

containing Descriptions of the Flowering Plants known from the Island. By William Fawcett and Dr. Alfred Barton Rendle. Vol. 7: Dicotyledons—Families Rubiaceæ to Compositæ. By the late Spencer Le Marchant Moore and A. B. Rendle. Pp. ix + 303. (London: British Museum (Natural History), 1936.) 15*s.*

THE continuation of this valuable work is very welcome, and we note with pleasure that there is every hope of its speedy completion. The present volume is filled almost entirely by the accounts of the Rubiaceæ and Compositæ, which were prepared by the late Mr. Spencer Moore and have been completed by Dr A. B. Rendle. The latter author has also worked out the Campanulaceæ, and has successfully unravelled the difficulties which obscured the identity of some of the ten species of *Lobelia* occurring in Jamaica. All students of tropical American plants will be grateful for the attention to nomenclature and synonymy, the care in examining historic types, and the general finish which have from the first been marks of this distinguished production.

Einführung in die Vektor- und Tensor-rechnung:

unter besonderer Berücksichtigung ihrer physikalischen Bedeutung. Von Prof. Dr. Harry Schmidt. Pp. vi + 125. (Leipzig: Max Jänecke, 1935.) 5.80 gold marks.

THIS is an excellent account of vector analysis, starting at the beginning, based on sound mathematical principles, and clearly explained. The vector theorems are well illustrated by hydrodynamical applications; the tensor of the second order (the work is carried no further) is exemplified by the theory of elasticity. The author believes that an exact treatment need not be more difficult, and is certainly easier to understand, than a popular exposition lacking in rigour and based on intuition. With this we entirely agree, and can recommend this book to all who wish to learn vector methods and their application.

The Search for the Isotopes of Hydrogen and Helium of Mass 3

By The Right Hon. Lord Rutherford, O.M., F.R.S.

After the discovery by Urey of the isotope of hydrogen of mass 2 (deuterium) and its concentration by electrolysis, it was natural to examine whether any other stable isotopes of hydrogen, and particularly ^{3}H (triterium, symbol T), are present in ordinary hydrogen. In this article an account will be given of the chequered history of the many investigations to throw light on this question, and incidentally also of attempts made to detect the presence of the helium isotope of mass 3, which is believed to be produced in certain transmutations.

It was natural to suppose that the concentration of deuterium by electrolysis of water should lead also to a concentration of triterium to a considerable extent. Using a direct spectroscopic method, Lewis and Spedding[1] in 1933 looked for the presence of a spectrum line corresponding to ^{3}H in hydrogen released from a rich sample of heavy water, but with negative results. They concluded that if triterium were present at all its concentration was less than 1 in 6×10^5, compared with ordinary hydrogen.

Experiments with a similar object were carried out in Princeton University in 1934 by Lozier, Smith and Bleakney[2]. A sensitive form of mass-spectrograph designed and operated by Bleakney was used to detect the presence of charged molecules TD of mass 5. They estimated that the concentration of T was about 5 in 10^6 after the initial volume of ordinary water had been reduced to 1 part in 225,000. The experiments were continued by Prof. H. S. Taylor and his collaborators[3] until the volume was reduced to 1 part in 150 million. In these experiments about 75 tons of ordinary water were electrolysed down to 0·5 c.c. The concentration of T/D using Bleakney's method was found to be about 1 in 10^4, and they concluded that the abundance of T in ordinary water was about 7 in 10^{10}.

In the meantime Oliphant and Harteck[4] in Cambridge had found definite evidence that the bombardment of a deuterium preparation by fast deuterons led to two types of transformation, in one of which an isotope of hydrogen of mass 3 was liberated, and in the other an isotope of helium of mass 3. From the energies released in these reactions, it was deduced that the masses of these two isotopes are nearly the same, namely, 3·0171 when the mass of a hydrogen atom is taken as 1·0081. The general evidence suggests that both these new isotopes are stable under normal conditions.

It was clear that it was matter of much scientific importance to obtain sufficient quantities of these new isotopes not only to determine their masses with precision but also to investigate the interesting transformations which might be expected to occur when the ions of these isotopes were used for bombarding purposes. An account will be given later of attempts to obtain detectable quantities of these gases by direct transmutation, but I will first deal with experiments to obtain detectable quantities of triterium by continued electrolysis of heavy water. Before the completion of the Princeton experiments, the feasibility of large-scale electrolysis was discussed by Prof. Urey with Prof. Tronstad and Engineer J. Brun of the Norsk Hydro-Elektrisk Kvoelstofaktieselskab of Oslo, Norway, which was producing heavy water in quantity by the electrolytic method. The most suitable methods to employ for the concentration of triterium were discussed by Dr. Farkas and Dr. Oliphant of Cambridge with the representatives of the Norwegian company, which very kindly agreed to carry out the elaborate research programme required. A brief statement of the methods employed, given by the Company, is as follows:

"If ordinary heavy water containing a small quantity of triterium oxide is electrolysed to a small volume, it is to be expected that, in all probability, it will become rich in T_2O. The object of the experiments was to try to accomplish this by electrolytic means.

"The basis used was 43·4 kilos of heavy water produced electrolytically and having an average D_2O content of 99·2 per cent. During the course of nine months and a half, this heavy water was electrolysed to a volume of 11 c.c.

"The electrolysis was carried out under conditions that ought to be considered favourable for the concentration of any triterium oxide that might happen to be present in the heavy water. During the first part of the electrolysis nickel cells provided with iron cathodes were used, but during the last part of the process glass cells with electrodes made of platinum were employed. The cells were constructed in such a manner that there was excellent communication between the anolyte and catholyte. In addition to this, provision was made for efficient reflux condensation of the water vapour, so as to ensure the purity of the gases developed by the electrolysis.

"The electrolyte used consisted of heavy potassium hydroxide—KOD. In order that the concentration of the electrolyte should not increase too much during the electrolysis, the potassium hydroxide was gradually eliminated from the electrolyte by distilling off the water. The D_2O content of the dry potassium hydroxide obtained by this process was regenerated by being first treated with dry CO_2, the water liberated thereby being then distilled and passed back to the cell.

"The density of the cathodic current during the electrolysis varied from 0·2–0·4 amp./cm.^{2}. The temperature of the electrolyte varied from 30° to 50° C.

"After the electrolysis had been completed, the contents of the cells were treated with dry CO_2 (for the purpose of converting the potash into carbonate), and the heavy water was distilled off. No further purification was effected."

Part of this concentrated material was handed to Dr. F. W. Aston to examine in his precision mass-spectrograph whether any triterium was present. The following statement of the behaviour of this material has been given to me by Dr. Aston:

"The vapour of the concentrated heavy water was allowed to pass continually through the discharge tube which was in a very favourable state, the diatomic molecular lines being about 1,000 times as bright as the triatomic. The line 5 was examined by a 40 minutes exposure and the limits of detection estimated by very short exposure of line 4 (D_2) down to 1 second. Line 5 was unquestionably D_2H and no trace of a companion in the position expected for DT could be detected. This would have been about 0·5 mm. away and easily resolved. A second test was made with an exposure of 50 minutes with the same result. As line 4 could have been detected with an exposure of 1/20 second, it follows that

$$\frac{DT}{D_2} < \frac{1}{50{,}000}\text{"}$$

The conclusion of Dr. Aston, that no trace of triterium could be found in the concentrated sample by his very direct and simple method, is very disappointing after the time and labour spent in Norway in preparing this material. While it is, of course, difficult to make any certain comparison of the concentration of T to be expected in these two large-scale experiments, it does not seem likely that the concentration of T would be less in the Norwegian experiment. I am informed by the Norwegian company that, in all, 13,000 tons of ordinary water were used for the production of the 43·4 kilos of heavy water employed by them to concentrate the triterium, while Taylor and his collaborators started with 75 tons. The rather low yield of heavy water in the Norwegian experiments was due to the fact that the cells used were ordinary technical electrolysers for the production of hydrogen and oxygen, heavy water being regarded as a by-product. In any case it is to be expected that in the earlier stages of the electrolysis the triterium would be enriched at least as much as the deuterium.

There is thus rather a conflict of evidence with regard to the concentration of triterium in the two similar experiments. The American observers obtained a positive result indicating a value of $T/D = 1/10^4$ in their enriched sample, while Aston by a more direct method could detect no triterium at all in the Norwegian preparation, and concludes that T/D must be less than 2 in 10^6. Unfortunately, an intercomparison of the samples is not possible, for Prof. H. S. Taylor informs me that their enriched sample has been lost. It is hoped, however, that it will be possible to arrange to test the Cambridge sample in Princeton by the sensitive method devised by Bleakney. It is important to decide that the ions of mass 5 shown by this apparatus are in fact due to molecular ions TD.

It was felt desirable, however, to confirm the negative result found by Aston by a transmutation test. This is in some cases a delicate method of analysis, as is shown by the fact that the presence of the small amount of deuterium in ordinary water can readily be observed by its use. Experiments were consequently made by Kempton and Miss Maasdorp in Cambridge, to test whether hydrogen separated from this concentrated material showed any characteristic difference from ordinary deuterium, when the accelerated ions were used for bombarding purposes. The ion beam was analysed by a magnetic field, and the part of mass 3, no doubt mainly due to charged DH molecules, was allowed to fall on a target consisting of a deuterium compound. The intensity of the beam of mass 3 was very small compared with that observed for the D ions. From general considerations, we might expect the following reactions to occur for fast ions corresponding to ^3H and ^3He:

$$\begin{aligned} {}^2D + {}^3H &\rightarrow {}^4He + {}^1n \\ {}^2D + {}^3He &\rightarrow {}^4He + {}^1H \end{aligned} \qquad \ldots \quad (1)$$

the energy released in each case being about 20 million volts. Owing to the copious production of neutrons from the ordinary D—D reaction, it is not possible to distinguish the small number of neutrons or protons to be expected from the above reactions. On the other hand, the α-particles arising from these reactions should have a range in air of 2–3 cm., and should be readily distinguished from protons, owing to their greater ionizing power. Careful search failed to reveal any such α-particles, and the number must have been less than 1/5,000 of the protons arising from the D—D reaction. Assuming that these reactions are all equally efficient at the voltage used, it follows that

$$T/D < 1/5{,}000.$$

While the limit of detection of T by this method is 10 times lower than that deduced by Aston, this conclusion nevertheless affords a useful check in indicating that very little if any T can be present.

It is desirable to add a short statement of attempts made to detect the artificial production of ^{3}H and ^{3}He in the D—D reaction already referred to. Since these transformations are highly efficient, and take place for very low bombarding energies, it is to be expected that both ^{3}H and ^{3}He should accumulate when an ordinary glow discharge is passed through heavy hydrogen. Accordingly experiments were carried out in America and in Cambridge to produce these new isotopes by passing heavy hydrogen slowly through a discharge tube across which a potential of 60–70 kilovolts was applied. Samples of the gas obtained by this treatment were tested in America for the presence of ^{3}H and ^{3}He by the sensitive method of Bleakney, previously mentioned. At first, evidence[5] of small traces of these gases was found, but we understand that later work has failed to confirm these conclusions.

In the Cambridge experiments made by Oliphant, the treated gas mixed with an excess of helium was passed through the discharge tube, which produced a beam of fast ions for experiments on transmutation. After acceleration, the beam of ions was analysed by passage through a magnetic field, and the ion beam of mass 3 was found to be very feeble compared with that of mass 2, owing to the presence of helium, which has the property of dissociating the charged molecules produced by the discharge. The method of detection of ^{3}H and ^{3}He was similar to that already described. A search was made for α-particles which might be expected to arise from the reactions (1), when the ions of mass 3 fell on a target containing deuterium. No such α-particles were detected, and the number was certainly less than 1/20,000 of the protons liberated from the deuteron beam under the same conditions. Assuming as before that these transformations are all of equal efficiency, it is evident that ^{3}H and ^{3}He cannot be present to the extent of 1/20,000 in the deuterium gas.

Attempts have been made by G. P. Thomson and F. A. Paneth in London to produce ^{3}He by the D—D reaction in sufficient quantity to be detected by the extremely sensitive micro-methods developed by Paneth, but so far without success. It may be that the reaction of ^{3}H and ^{3}He with D takes place very easily, so that a stage is soon reached when these isotopes are destroyed in the discharge as fast as they are produced.

The rapid disappearance of ^{3}H and ^{3}He by transmutation would account for the very small abundance of these isotopes in the earth and presumably in the sun. A number of experiments have been made to detect the helium isotope of mass 3 in ordinary helium by direct spectroscopic methods, but with entirely negative results. This, however, is not surprising when we consider that terrestrial helium is probably derived from the α-particles of mass 4 expelled from the radioactive substances present on our earth.

It is a striking fact that while in transmutation experiments using counting methods the D—D reaction is on a marked scale, giving rise to very large numbers of ^{3}H and ^{3}He particles, yet it does not seem feasible at the moment to obtain sufficient quantities of these two interesting isotopes to study their properties by ordinary physical chemical methods.

[1] Lewis and Spedding, *Phys. Rev.*, **43**, 464 (1933).

[2] Lozier, Smith and Bleakney, *Phys. Rev.*, **45**, 655 (1934).

[3] Schwood, Taylor, Lozier and Bleakney, *J. Amer. Chem. Soc.*, **57**, 780 (1935).

[4] Oliphant, Harteck and Rutherford, *Proc. Roy. Soc.*, A, **144**, 692 (1934). Oliphant, NATURE, **137**, 396 (1936).

[5] Bleakney, Harnwell, Lozier, Smith and Smyth, *Phys. Rev.*, **46**, 81 (1934).

Social and Political Application of Nutritional Science

THE historical development of any science is twofold. First come the discoveries of natural principles and facts of theoretical interest. These are followed at varying intervals of time by their application to practical life. The history of nutritional science offers no exception to this rule.

Recently, the trend of nutritional investigation has undergone a marked change. While disinterested studies of a purely theoretical nature will always bulk large in the pages of scientific journals, there is clear evidence that pride of place is now being given to researches which will hasten the practical application of the new nutritional teaching. In short, there are welcome signs of a lessening gap in the relations between those who are engaged in ascertaining the facts of nutrition and those whose duty is the application of that knowledge to the practical affairs of public health.

Some evidence of this will be found in the fact that the number of papers noted in the section of *Nutrition Abstracts and Reviews* (published by the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Aberdeen), devoted to the application of nutrition to human health has increased by more than 90 per cent in the last five years.

The two outstanding features of present-day investigations are first, the attention which is being paid to the determination of nutritional needs, and secondly, the ascertainment of the extent of means to supply these needs. The economic blizzard which struck the world in the years around 1931 gave tremendous stimulus to this type of study, and we find the world's literature during the years of depression abounding in papers dealing with the influence of the economic crisis on the nutritional needs and health of the people, the dietary resources of the unemployed in relation to their physical fitness, and the prevalence of malnutrition in children and young persons living under conditions of limited means in distressed areas.

The relation between poverty and national physique has been re-examined in the light of our new knowledge of nutritional needs. Many recent studies have shown that as income increases the greater is the consumption of milk, eggs, fruit, vegetables, meat and fish. This finding is not altogether new. It has long been established from the innumerable records of family expenditures published by the well-known economists of the nineteenth century that additional increases in income are associated with an increasing amount spent on food, and further, that the struggle to consume better kinds of nourishment is greater than the striving to increase total amounts of consumption. Le Play and Engel, who were the first to generalize these laws, maintained that the upper classes were to be differentiated from the lower by the amounts of animal food they consumed.

What is entirely new, however, is the realization that rising income, associated with increased consumption of milk, eggs, fruit and the rest, goes hand in hand with decreased death-rate, better growth of children, greater adult stature and much improved general health. The explanation of this lies in the fact that the foods mentioned are just those found to be richest in vitamins, mineral matter and first-class protein, constituents proved by laboratory experiments to be essential for the preservation of health. This is the crux of what has been called 'the newer knowledge of nutrition'. It calls for a change in point of view rather than any fundamental or revolutionary alteration in dietary habits.

Undoubtedly, disquieting features in the state of national fitness have been revealed as a result of these recent dietary and family budget investigations in Great Britain, and very naturally a lively public interest in the whole nutrition question has been aroused. Social conscience is especially sensitive because, not only in Great Britain but also in many other countries, it has been estimated that a very large proportion of the population falls into groups in which the income per head is less than that considered sufficient for the purchase of foods necessary for the maintenance of optimum health. The unfulfilled needs of the people of Great Britain for essential foodstuffs have been assessed at £200,000,000 a year.

Inevitably, controversy has arisen. On the question of needs, typical examples of disagreement are those which surround the standards advocated by expert medical opinion and those adopted by Government departments responsible for unemployment assistance and other forms of public relief. In official circles the inclination has been to think in terms of minimum needs ; that is to say, the level fulfilling conditions which would keep the population at the present average standard of health and physique. The scientific investigator, on the other hand, cannot conscientiously study anything less than an optimum, which has been defined as a level of requirement above which no subsequent addition would add to the individual's share of good health and of full physical development. Again, the absence of precise objective standards by which to measure the state of nutrition of a given individual offers another serious difficulty. The adoption of differing standards and the varying mental conceptions and impressions of individual observers have led to confusion in the assessment of malnutrition and the subsequent comparison of data from different sources. As a result, allegations that substantial and progressive declines in the health of communities have followed the years of economic depression are often difficult either to refute or to substantiate. Further fuel has been added to the fire of controversy by the expressed opinion of statisticians that some of the most recent contributors to the discussion on the relation between poverty and nutrition have based their findings on faulty methods and meagre and uncertain data.

The task of those who would distinguish what is true from what is false is not made any easier by the number of different bodies, official and non-official, which have contributed to the discussion. Data from all sorts of different sources—medical, chemical, physiological, social—have been accumulated piecemeal.

Questions of nutrition now regularly form an outstanding feature of the official reports, issued from the Ministry of Health and the Board of Education, dealing with the state of national health and the welfare of infants and school children; and, year by year the number of local authorities which have instituted inquiry into nutritional conditions in their own areas becomes greater and greater. Further, in Great Britain at any rate, there have arisen within the last few years numerous semi-private organizations the self-imposed task of which is partly to educate the 'man in the street' upon what is properly considered to be a matter of immediate public concern, and partly to stimulate official circles into making authoritative pronouncements regarding what constitutes an adequate diet and how the Government proposes to bring such a diet within the economic compass of every section of the community. Chief among these are: the Committee Against Malnutrition, the Children's Minimum Council, the People's League of Health, and PEP (Political and Economic Planning), all of which have, by well-directed propaganda and other means, done much to focus public attention on the urgent need for the formulation of a sound national nutrition policy.

Whatever may be one's opinion on the validity of individual statistics purporting to show the extent of malnutrition and its precise relationship to family habits and circumstances, there is no doubt that, viewed in the widest perspective, a serious amount of malnutrition prevails in almost every country in the world, especially among children. Furthermore, it seems that where the dietary standards fail, the major cause is not ignorance but poverty.

It is not surprising, therefore, that following the presentation of facts there should have been a cry for official action. Before action can be taken, however, the public health administrator must satisfy himself that the principles suggested to him by the scientific investigator do really concern him. Broad generalizations must be accepted with caution. Alarmist statements on the prevalence of under-nutrition must be considered judicially. Facts must be verified and must be interpreted with greater precision in order to determine whether action is justified and what form it should take. The tendency in Government circles, therefore, has been towards further inquiry rather than to the hasty acceptance of the new ideas.

In the United Kingdom, the Minister of Health and the Secretary of State for Scotland appointed, in May 1935, an Advisory Committee to examine the quantitative and qualitative facts of nutrition and to report as to any changes in the diet of the people which might appear desirable in the light of modern advances in our knowledge. This Committee has recently issued its first report, the outstanding features of which are the Committee's adoption of the standards of dietary requirements drawn up by the League of Nations Committee to which reference is made below, its recognition of the importance of milk and its recommendation that in impending legislation dealing with the national milk supply the primary objective of the Government should be to ensure that specified amounts (two pints per day for every pregnant and nursing mother, and a pint and a half for every child) are brought within the purchasing power of the poorest. It has also accepted as reasonable and likely to be in accordance with the facts, the broad picture on food consumption at different income levels prepared by the Market Supply Committee and used by Orr as the basis of his estimates in "Food, Health and Income"; but recommends that it should be regarded not as final but rather as a framework to be filled in when an adequate number of budgets have been obtained and individually analysed. These are conclusions of far-reaching importance.

Of much wider interest, however, is the attention which has been paid to the nutrition question by the League of Nations. The Health Organisation has been engaged in the study of nutrition in its relation to public health since 1925. On the proposal of the Australian delegate, who, incidentally, was one of the first to appreciate the close nexus of interest between problems of health and agriculture, the League, at its sixteenth Assembly in 1935, recommended that the Health Organisation should continue and develop its work on nutrition in collaboration with the International Labour Office and the International Institute of Agriculture. At the same time, the Assembly decided upon the creation of a Mixed Committee of experts on agriculture, economics and public health, charged with the duty of presenting a general report to the Assembly on the problem of nutrition in its public health and economic aspects. The nineteenth International Labour Conference adopted a similar recommendation. In October 1935, the Health Committee decided to set up a Technical Commission on Nutrition composed of three experts each from the United Kingdom, the United States and France, and one from each of six other European countries. This Commission, at its first session in London in November 1935, laid down the physiological bases of nutrition and established the food requirements of human beings during their growth from conception until adult age. With a view to the application of these recommendations in different countries and their adaptation to varying geographic, economic and social conditions, the report was circulated for the observations of academies of medicine, research councils and other authorities in various countries the competence of which covers nutritional problems. At its second session, held in Geneva in June 1936, the Technical Commission examined the observations communicated by these bodies, revised and amplified its London report, and presented it to the Mixed Committee in conformity with the Assembly's resolution of 1935.

This revised report, embodying considered international opinion on human dietary standards, represents the first and most outstanding contribution towards evolving order out of the chaos of specialized data on requirements which has confronted nutritional workers in recent years. A yardstick has at last been provided by which to measure diets and determine how far they are deficient for health. As already mentioned, the report has been adopted by the Advisory Committee on Nutrition responsible to the British Ministry of Health, and, in common with all the other work of the League's Technical Commission on Nutrition, has created a considerable impression not only in Europe but also over-seas. Thus, items included on the agenda of the Inter-Governmental Conference of Far-Eastern Countries on Rural Hygiene have been inspired by the Commission's work, as also has the recent formation of numerous national councils, such as those in Australia and in the British Colonies, specially set up to study local nutritional problems along the lines of the League's recommendations.

Perhaps nowhere have the suggestions of the League been acted upon with greater promptitude than within the British Colonial Empire. In April 1936, the Secretary of State for the Colonies addressed a dispatch calling for a comprehensive survey of the nutrition position in each Dependency. One of the main purposes of the dispatch was to direct attention to the important bearing which nutrition should have upon agricultural, veterinary, educational and general policy in the Colonial Empire. In planning the production of any territory the aim should be twofold; on one hand, the provision to the entire population of a locally grown food supply considered adequate by medical science and, on the other, the growth of remunerative export crops. Already many replies have been received, some of which have been made available as public documents. "Food in Relation to Health" has been issued by the recently established Nutrition Committee in Trinidad; a similar report, based on the well-known work of Nicholls, describes conditions as they apply in Ceylon; the report of a specially formed nutrition committee has been presented to the Legislative Council of British Guiana; and a "Nutritional Review of the Natives of Zanzibar" has also been submitted.

To consider these reports and to advise generally on nutritional matters relating to the British Colonial Empire, the Prime Minister, in November 1936, appointed a Committee of the Economic Advisory Council consisting of medical, agricultural and economic specialists. This Committee is expressly commissioned to keep in touch with the work of the League of Nations and enable His Majesty's Government to assist and support it more effectually.

No attempt has been made here to deal exhaustively with the subject under review. Rather the aim has been to present a brief general outline touching the reasons for, and the nature of, Government intervention and official international co-operation on a subject of intense universal interest. Unavoidably, the writer's approach has been from the British point of view. One must remember, however, that in the United States of America, in the U.S.S.R., in Italy and in many other countries, evidence that Governments have accepted their obligations to give authoritative public guidance on questions of nutrition is equally conspicuous.

By far the most important thing is that the League of Nations has been accepted as the common platform on which national aspects of the problem can be debated in their world setting and in an atmosphere of reason and mutual comprehension.

Obituary Notices

Prof. J. W. Michaelsen

PROF. J. WILHELM MICHAELSEN, *Hauptkustos* in the Hamburg Zoological Museum, died on February 18 in his seventy-seventh year. Born in Hamburg, he joined the Hamburg Museum in 1887 and worked there until the time of his death. As a young man he became interested in the Oligochæta, and from 1886 until his death he wrote many papers on their anatomy, classification and geographical distribution. He also wrote on the Tunicates and the Polychæta, but his main interest was the Oligochætes, and it would be difficult to over-estimate the extent of his contribution to our knowledge of this group. Vastly learned, disinterested and careful of minutiæ he belonged to the great tradition of German scholarship, and the sheer quantity of his work—his papers on the Oligochæta alone bind up into eight very bulky volumes—testifies to an extraordinary industry and persistence of motive. In addition to this, he found time to make journeys to the southernmost corners of America, Africa and Australia in pursuit of evidence to throw light on the palæogeographical problems arising out of his study of Oligochæte distribution.

There has never been any question as to the consistently high quality of Michaelsen's work, and his co-specialist and in his own line his only peer, the late J. Stephenson, has for a heading to his monumental monograph on the Oligochæta (Oxford Univ. Press, 1930) the words, "To my Friend and Master W. Michaelsen of Hamburg".

Those of a younger generation who had the good fortune to correspond with Michaelsen will testify to his great kindness and patience. Even when he was a man in the seventies he would go to extraordinary lengths to assist a beginner who applied to him for help or information. On one occasion, he copied out a whole paper himself by hand and traced the drawings to send to a young student who wrote to say that the particular work was not available. He had the rare characteristic of cheerfully acknowledging his own mistakes, and was entirely free from that failing which overtakes so many men who have devoted their lives to the mastery of a specialism, the failing which consists in treating a difference of opinion, especially one coming from a younger man, as a personal affront. His letters reveal a simple, unexpectedly humorous and kindly man.

Prof. A. Erman

THE death of Prof. Adolf Erman on June 26 inflicts an incalculable bereavement upon both the Egyptological world and a large circle outside it. In the realms of his own subject he was without doubt regarded as the foremost scholar, since it was he who first placed the study of the ancient Egyptian language upon a scientific basis. His "Ägyptische Grammatik", which first appeared in 1894 and which was destined to pass through four editions, revolutionized the method of approach to the classical language, while the later phase of Egyptian, known as "New Egyptian", was fully dealt with in his "Neuägyptische Grammatik" of 1880 and 1933. Yet he was far from belonging to that class, all too large even at the present day, of specialists who never trouble to interpret their discoveries for the benefit of the general reader. He could write excellent descriptive prose, informed by a considerable sense of humour, which presented a living picture to his readers, as in his "Ägypten", translated into English by Lady Tirard under the title of "Life in Ancient Egypt", his "Religion der Ägypter", translated by the same author and called "Handbook of the Egyptian Religion", and his "Literatur der Ägypter" of which the English edition has been prepared by Prof. A. M. Blackman. The last-named book is perhaps his greatest contribution of this kind, enabling the student of the past for the first time to become acquainted with specimens of ancient Egyptian literature of all periods, beautifully translated and explained.

The greatest of Erman's undertakings, however, was the enterprise of the Berlin hieroglyphic dictionary, which he edited jointly with other colleagues. This vast work, intended to cover the whole history of ancient Egyptian, is still in process of publication, the first five volumes having appeared between the years 1926 and 1931. It has been justly said that the wide range of Erman's abilities made him an interpreter of Egyptian civilization unrivalled by any other except the Frenchman Gaston Maspero. He has left to his successors a standard of scholarship which can only be maintained if the scientific principles which he so assiduously taught during his long life are faithfully obeyed. A. W. SHORTER.

WE regret to announce the death on August 3 of Prof. Josef Woldřich, director of the State Geological Institute at Prague, at the age of fifty-seven years. Born in Vienna, Prof. Woldřich became well known in Central Europe for his geological investigations, which began with a re-examination of certain Bohemian rocks, notably those studied by the Frenchman Barrande and more recently by the late Prof. J. E. Marr of Cambridge. After the Great War, he was appointed to the chair of geology at the new University of Brno in Moravia. Here he commenced a series of geological studies of the lesser-known districts of Slovakia, a work of extreme importance for the compilation of the modern geological maps of Czechoslovakia. He had been director of the State Geological Institute for the past three years.

WE regret to announce the following deaths:

M. André Beaumont (M. Jean-Louis Conneau), one of the pioneers of aviation, aged fifty-seven years.

Dr. W. M. Cumming, lecturer in bacteriology in University College, Dundee, an authority on tuberculosis, aged thirty-nine years.

Mr. C. E. L. Gilbert, C.I.E., formerly chief conservator of forests, Bombay Presidency, on August 8.

Prof. Vernon L. Kellogg, professor of entomology in Stanford University in 1896–1920, permanent secretary of the U.S. National Research Council in 1920–32, aged sixty-nine years.

Prof. Hans Reck, the distinguished German volcanologist, who was associated with the discovery of human remains at Oldoway, Tanganyika, in 1914, on August 4, aged fifty-one years.

Prof. A. E. Seaman, emeritus professor of geology and mineralogy in the Michigan College of Mining and Technology, on July 9, aged seventy-nine years.

Mr. A. Sharples, formerly Government mycologist, Federated Malay States, and head of the Division of Plant Pathology, Rubber Research Institute of Malaya, on August 6.

Mr. J. W. N. Sullivan, author of "Three Men Discuss Relativity" and other books of a popular character on aspects of modern science, on August 12, aged fifty-one years.

Prof. J. G. Thomson, professor of medical protozoology in the London School of Hygiene and Tropical Medicine, on August 13.

News and Views

The Sun's Outer Envelope

According to a cabled statement from the New York correspondent of *The Times* published on August 14, Major Stevens of the United States Army, flying over Peru at a height of 30,000 ft. on June 8, during the total solar eclipse, obtained some very surprising photographs of the eclipsed sun. Surrounding the corona with its irregular streamers, there was found a bright envelope one million miles high in which the details of the corona became insignificant. The first natural reaction is to ascribe this result to photographic effects of over-exposure, especially as no details of the size of the image secured or other optical details of the apparatus used are given. But the name of Harvard University behind the announcement renders one unwilling to look to any simple instrumental explanation of this unexpected phenomenon. A link between the corona and the zodiacal light seems suggested, but no indication is given in the report of any extension in the zodiacal plane, such as would be expected. Again, since the zodiacal light and the corona both have the same distribution of radiation as ordinary sunlight, one would expect any connecting matter to be similarly conditioned. Only over-exposure, which blots out all coronal details, would account for the even globular envelope unless this outer envelope is relatively much stronger in light of short wavelength. It would be interesting to know what visual observations were made from the aeroplane. If these agreed in general outline with the photographs secured from the ground, then the photographs from the stratosphere suggest an extensive outer atmosphere giving bright line or bright band radiation which must be examined spectroscopically at the next suitable total eclipse. Further and fuller details of the photographs will be impatiently awaited.

Anglo-Egyptian Treaty Honours List

The additional Egyptian Honours List issued in connexion with the signing of the Anglo-Egyptian Treaty in London, and published in the *Egyptian Mail* of July 28, contains the names of the following men of science: *Third Class of the Order of Ismail* (Commander), Dr. E. Hurst, director-general of the Physical Department of the Ministry of Works, and Mr. F. Newhouse, inspector-general of irrigation in the Sudan; *Second Class of the Order of the Nile* (Grand Officer), Dr. Roy S. Dobbin, professor of obstetrics in the Egyptian University, Cairo; *Third Class of the Order of the Nile* (Commander), Dr. J. Templeton, chief botanist, Botanical and Plant Breeding Section, and Dr. W. T. H. Williamson, chief chemist, Chemical Section, of the Ministry of Agriculture, Dr. J. H. Grindley, expert for technical education, Major W. L. Forsyth, professor of bacteriology, and Prof. D. H. Bangham, dean of the faculty of science in the Egyptian University, Cairo; *Fourth Class of the Order of the Nile* (Officer), Mr. G. H. Jones, director of the Mycological Section, Prof. H. Priesner, director of entomological research, and Mr. C. H. Broun, senior botanist of the Ministry of Agriculture, Prof. T. L. R. Ayres, professor of physics, Dr. O. Zdanski, professor of geology, and Prof. A. Naef, professor of zoology in the Egyptian University, Cairo.

Centenary of Dr. Edmund Weiss (1837–1917)

On August 26, 1837, Dr. Edmund Weiss, the distinguished Austrian astronomer, was born at Freiwaldau, in Austrian Silesia. A part of his boyhood was spent in England, where his father was physician to a health institution, but he received his education at Troppau and at the University of Vienna, and at nineteen years of age became assistant to Karl von Littrow (1811–77) in the old Vienna Observatory which had been erected in 1826 by Joseph von Littrow (1781–1840) on the site of the observatory established by Father Maximilian Hell, *S.J.*, in 1753. At first Weiss was employed on geodetic work, but it being proposed to remove the old observatory, which was situated among the narrow streets of the Austrian capital, to a more favourable situation, Weiss, in 1872, was sent on a tour of European and American observatories to study their methods, and optical works, and to him fell the task of planning the equipment of the new observatory at Währing, the foundation stone of which was laid in June 1874. On von Littrow's death in 1877 Weiss was appointed to the directorship. This post he held for thirty-two years, retiring in 1910. He died on June 21, 1917, at the age of seventy-nine years. During his career Weiss took part in several eclipse expeditions, was one of the observers of the transit of Venus in 1874, wrote on comets, meteors and orbits, and prepared a revised edition of Oeltzen's catalogue of Argelander's zones from 15° to 31° S. declination. He was a member of the Vienna Academy, a *correspondant* of the Paris Academy of Sciences, and for thirty-four years an associate of the Royal Astronomical Society.

Reginald Harrison (1837–1908)

Mr. Reginald Harrison, who was equally eminent as a Liverpool and as a London surgeon, was born at Stafford on August 24, 1837. He was educated at Rossall School and St. Bartholomew's Hospital, and qualified in 1859. In 1866 he became fellow of the Royal College of Surgeons, and the following year was appointed assistant physician to the Royal Infirmary, Liverpool, becoming full surgeon in 1874. He was at first a general surgeon, but before long he specialized in diseases of the male genito-urinary system, and in 1889 he left Liverpool for London on his appointment as surgeon to St. Peter's Hospital for Stone and Other Urinary

Diseases. Harrison was the author of "Surgical Disorders of the Urinary Organs" which became a standard text-book, and went through four editions, as well as of "Selected Papers on Stone, Prostate and Other Urinary Diseases" and "The Use of the Ambulance in Civil Practice". During his residence in Liverpool he re-organized medical education at the Royal Infirmary, and took an active part in the introduction of the ambulance system, in which he continued to take an interest after his removal to London, being president of the Street Ambulance Association at the time of his death. He was the recipient of many distinctions, including those of Knight of Grace of the Order of St. John of Jerusalem, president of the Medical Society of London, and Hunterian professor of surgery and pathology of the Royal College of Surgeons. In 1903 he inspected the School of Medicine at Cairo for that College and received the Imperial Ottoman Order of the Medjidie.

Roman Dorchester

THE Dorset Natural History and Archæological Society, concurrently with its share in the excavation of Maiden Castle, is investigating a site at Colliton Park, Dorchester, on which a county hall is to be erected. The site is within the walls of the Roman city and has not been built on since Roman times. In view of its situation, it was thought probable that Roman buildings would be found there, and the last opportunity upon which the site would be available for examination could not be allowed to pass by. Already, it is reported (*The Times*, Aug. 14), a large part of a house has been disclosed, of which one range of five rooms contains three for bathing, a central dressing-room, with a hot bath on one side with its hypocaust, still largely intact, and on the other side the cold bath-room. North of this range of rooms is a corridor looking out on the courtyard, in which is the well, now cleared to a depth of thirty feet. The filling of the well was found to be entirely composed of wreckage from the building, and included broken parts of at least nine stone columns, four of which are complete though fractured. They probably formed the colonnade of the corridor. At right-angles to the first range of rooms is a second, consisting of seven rooms. All these have mosaic floors, of which one is in perfect condition, while another, though badly damaged, still shows traces of considerable beauty. This latter has panels containing a head of Flora and another head which has not yet been identified. One of these rooms has a hypocaust beneath. An unusual feature in a Roman house in Britain is the lower part of two windows with internal splays. As this house is clear of the building line of the new hall it is hoped to preserve it intact. Trial trenches are being dug to find the other buildings which are thought to lie beneath the surface. As the whole area is to be explored, further financial assistance towards the considerable cost is required.

The Gyro Compass on the Hudson Bay Route

IN a summary of the eighth report of the Imperial Shipping Committee on Hudson Bay Marine Insurance Rates, published by H.M. Stationery Office, 3d. net, which appears in *The Times* of August 13, it is mentioned without comment that the Committee quotes tributes by captains of ships to the value of a gyro compass in contributing to the confidence with which the Strait and Bay were navigated. It is stated that other masters have expressed the view that a gyro compass is essential for navigating the Hudson Bay with safety. The Committee submitted to the underwriters that a further reduction of premiums should be made in respect of vessels equipped with gyro. An illustration is given of the saving of premium which could be effected by installing a gyro compass for one voyage, two voyages, and three voyages in the same season; against this is set the cost of hiring a gyro compass for, say, three months, which including fitting would, it is stated, be approximately £200, plus a very small charge for inspection. The Committee concludes that there is now a considerable inducement to the owner of a vessel to instal a gyro compass for voyages to the Hudson Bay. A gyro compass is specially desirable in the Hudson Bay area on account of the proximity of the north magnetic pole, off the Prince of Wales Land; a ship entering Hudson Bay must approach this pole within at least 14°, and owing to the low value of the horizontal magnetic force (which becomes zero at the magnetic pole), the directive force on the compass is low, and disturbances have a proportionately large effect. On the other hand, the distance from the geographical pole, which is one of the factors in determining the directive efficiency of the gyro compass, is more than 25°.

Electricity and Marketing

AN account is given of the Farmer's Conference at the Royal Agricultural Show held at Wolverhampton on July 8, in the *Electrician* of July 16. Mr. F. H. Slade read a useful practical paper on "Electricity and Marketing". He said that now the rural distribution of electricity is extending so rapidly, the British farmer will be able to compete on better terms with the foreigner. He described machines for the electro-mechanical grading and packing of fruits. Such machines will grade in one hour 700 lb. of gooseberries or 1,400 lb. of plums or 180 boxes of tomatoes, without bruising them and with less loss of bloom than by hand methods. A 1½ h.p. electric motor can divide hard fruit into fine sizes and two qualities at the rate of 1,000 bushels per day, ready for cold storage. It pays a grower having 20 acres or more to instal grading and refrigerating plant. The care of apples in a refrigerator is a matter of 'atmospheric control'. In a suitable atmosphere the fruit can have its life-cycle speeded up fifty per cent or the ripening of the fruit can be slowed down by fifty per cent. The average cost of cooling milk in a refrigerator for dairy purposes costs on an average about a penny for thirty gallons. Refrigerated stores for eggs are replacing water-glass immersion. Thanks to electricity, the British farmer, instead of merely getting low prices in season and losing markets out of season to foreign competitors, is now in a much better position to get profitable returns. Mr. Borlase Matthews mentioned that eight years ago there were 600 British farmers using electricity; the number now is more than 30,000. He mentioned that electricity was available to every exhibitor in the Show and for the first time they had a telephone exchange in the Show yard.

Practical Difficulties in International Telephony

In Europe, telephone operation is mostly in the hands of State administrations, although there are some large private telephone undertakings. To ensure satisfactory international joint working, uniform provisions for the calls are an indispensable necessity. With this end in view, the International Consultative Committee for Telephony, known as the C.C.I.F., has drafted recommendations and working instructions intended for application to international telephone traffic. In the *Ericsson Review*, No. 1, 1937, Mr. A. Lignell, director of telephones at Stockholm, discusses these recommendations from the point of view of practical operation. He points out that an international call makes use of the subscriber's line, the exchange equipment at both ends and one or more international lines, as well as two or more operators for making the connexions. This type of call is much more difficult to deal with both in respect of time occupied and handling than a local call, and as a rule is of greater importance than a purely local connexion. The C.C.I.F. has therefore recommended that a local call ought to be cut off to allow of an international call, and this is prescribed in its "instructions to operators". At the plenary meeting of the C.C.I.F. in Copenhagen in 1936, there was formulated a question to the following effect, namely, whether international calls should be established with the "least possible delay", instead of connecting them immediately, and so simplifying and cheapening the equipment of local and trunk exchanges. Mr. Lignell is afraid that such simplification would lead to appreciable economic and other disadvantages in international traffic. At the present costs of trunk lines, this seems inevitable. It is to be hoped that the priority over internal traffic which international regulations accord to international traffic may be maintained.

Illuminated Show Cases

When lamp fittings are used in the normal way, electricians usually assume that the ambient temperature is about 27° C. and this gives a rise of 23° C. in the connecting leads before the maximum permissible operating temperature (50° C.) of the rubber insulation is attained. If the lamp fittings are used in enclosed shop windows or show cases, the assumption about the ambient temperature is no longer valid, as it depends on the aggregate wattage of the lamps in the enclosure. In a technical report of the Electrical Research Association (E.R.A.) published in *World Power* of April, a very thorough research by H. G. Taylor, W. Lethersich and the late P. D. Morgan has been made to find out the actual heating and to suggest methods of reducing the ambient temperature when excessive. Four methods are considered. A fan can be used to disturb the air, and so provide a uniform temperature throughout the enclosure. Another method is to provide natural ventilation by holes at the top of the case for egress of the hot air and others at the bottom for ingress of the cold air. Forced ventilation may also be used. The last method considered is to use special glass which either transmits the infra-red rays emitted by the lamps, etc., or has a high thermal conductivity and so facilitates the transfer of heat from the inside to the outside of the show case. The first two methods were found to be of considerable value. It was found that if the area of the holes bored in the top and bottom of the show case was about 4 per cent of the area of the top and bottom, the maximum temperature rise was reduced by fifty per cent.

Oil Transport in the Middle East

So far as is known, the large oil-fields of the Middle East are situated in Iran and Iraq. In Iraq the principal producing field is in the neighbourhood of Kirkup to the east of the Tigris and 145 miles north of Bagdad. In Iran, oil is derived mainly from two large oil-fields. The exploitation of petroleum on a modern commercial scale in these countries is a very recent development which is producing social changes in the ways of the inhabitants, and in the economic sphere it is widening the basis of trade, increasing the revenue and bringing money into the country. In the Year Book of the Cambridge University Engineers' Association for 1936, Colonel H. E. Medlicott describes the engineering difficulties of constructing 1,600 miles of roadway in Iran, sometimes skirting precipitous hillsides. The Anglo-Iranian Oil Company has already raised more than seventy million tons of oil from the two main oil-fields. In Iraq, the Iraq Petroleum Company had under its concession to construct a pipe-line system from Kirkup to the Mediterranean. It was decided that the line should debouch at two points on the Mediterranean, Haifa to the south and Tripoli to the north. The distance along the pipe-line route from Kirkup to the Euphrates is 156 miles, and from there two sections bifurcate, the southern section going to Haifa and the northern section traversing Syria to Tripoli. The crossings of the Tigris and the Euphrates had to be made by 'Blondins' (overhead cable ways) and steel towers about 140 feet in height had to be erected in concrete to support the massive steel ropeways over the rivers which carried loads of ten tons from one bank and deposited them on the other. The author is strongly of the opinion that the Middle Eastern history of the near future will be a record of steady progress, sociologically, economically and politically.

Mining and Geology in South Australia

We have received the annual report of the Director of Mines and Government Geologist of South Australia for 1935 (Adelaide: Government Printer, 1936). After a lengthy list showing that more than a hundred plaints were investigated by the wardens, there is a series of short reports concerning mineral deposits, of which the most interesting is probably that "the Government Geologist was appointed to the Geological Advisory Committee assisting the operations of the Anglo-Persian Company's geologists who are making an examination of Australian territory for The Commonwealth Oil Refineries Ltd." This is followed by a report of the chief inspector of mines on the inspection work, whilst the general manager gives a report of the operations of State batteries and cyanide works. The mineral production of 1841–1935 closes the report, and shows a value of only a little more than 55 million pounds, of which three fifths is derived from copper ore and a quarter derived from iron ore. We have also received the Mining Review (No. 64) for the half-year ending June 30, 1936, of the South Australian Department of Mines. The review records the progress of mining operations in the first half of last year. The large-scale operations at Iron Knob and the many small gold mines scattered throughout South Australia are particularly noted.

The Problem of Reality in Physics

THE April number of *Current Science* contains a report of a lecture delivered at the Indian Institute of Science, Bangalore, by Prof. R. Ortvay, of Budapest, on "The Problem of Reality in Physics". Prof. Ortvay outlined the positivistic and realistic attitudes in physical science, the contrast between which he described as analogous to the relation between nominalism and realism in philosophy. To the positivist our only direct data are sensations, which alone constitute physical reality. All other 'existence' is constructed mentally out of sensations, and possesses a lower degree of importance. It follows that it is a senseless question whether anything exists that cannot be observed. This doctrine originated with Mach, and is shared by Bohr, Heisenberg, Dirac, Schrödinger and Philipp Franck. On the other hand, physical realism, the chief representatives of which in physics are Planck, Laue and Sommerfeld, chooses as its fundamental task the construction of a description of the world which is independent of our individuality. In Prof. Ortvay's opinion, positivism and realism are ultimately equally legitimate, just as in a logical system it is to a certain degree arbitrary what is to be considered as belonging to the basis of the system and what as a deduction. Positivism, in the form which was developed under the influence of quantum mechanics, leads to a profound change of our idea of the physical state of a system, but does not destroy the notion of the objectivity of a state, and so is not beyond realistic expression. On the other hand, Prof. Ortvay does not agree with the identification of observability and existence. He believes that we must maintain that certain things exist which can never be observed.

Research on Radium Therapy

RADIUM therapy in Great Britain was given a great stimulus with the formation of the Radium Beam Therapy Research unit towards the end of 1933. A series of papers during the last two years shows valuable contributions on many sides of the subject. Two of these papers have appeared in NATURE, one in the *Journal of Scientific Instruments* upon the properties of a new tungsten-nickel-copper alloy, the remaining seven in the *British Journal of Radiology*. Most of these papers are contributed by physicists, and deal in an exhaustive way with the physical properties of the radiation used and its intensity variations among the tissues that it penetrates. One paper, entitled "Delivery, Estimation and Control of Tissue Dosage in Radiation Therapy", by C. A. P. Wood and T. A. Green, exhibits in the most happy way how the carefully acquired physical data are being put to the direct service of the clinic. This paper may be said to mark an advance in the development of the use of big radium units in the treatment of cancer. The paper shows the importance of a knowledge of the state of radio-sensitiveness of the tumours being treated and how a best selection of the ports of entry of the radiation can only be made by those having the necessary anatomical knowledge combined with experience of the various modes of spread of cancer.

Indian Science Congress Association: Silver Jubilee

THE twenty-fifth annual session of the Indian Science Congress Association will be held in Calcutta on January 3–9 under the presidency of the Right Hon. Lord Rutherford. To mark the silver jubilee of the Association, the meeting is to be a joint session with the British Association. About a hundred men of science have been invited from Great Britain, while invitations have also been extended to a number of scientific workers in other countries. The Congress will be divided into the following sections under the presidents named: (1) Mathematics and Physics, Dr. C. W. B. Normand, director-general of observatories, Meteorological Office, Poona 5; (2) Chemistry, Prof. S. S. Bhatnagar, director, University Chemical Laboratories, Lahore; (3) Geology, Mr. D. N. Wadia, officiating superintending geologist, Geological Survey of India, 27 Chowringhee, Calcutta; (4) Geography and Geodesy, Dr. A. M. Heron, director, Geological Survey of India, 27 Chowringhee, Calcutta; (5) Botany, Prof. B. Sahni, professor of botany, University of Lucknow; (6) Zoology, Prof. G. Matthai, professor of zoology, Government College, Lahore; (7) Entomology, Mr. M. Afzal Husain, principal, Punjab Agricultural College, Lyallpur, Punjab; (8) Anthropology, Dr. B. S. Guha, Zoological Survey of India, Indian Museum, Calcutta; (9) Agriculture, Rao Bahadur T. S. Venkatraman, Imperial sugar-cane expert, Lawley Road, Coimbatore; (10) Medical Research, Sir Upendranath Brahmachari, professor of tropical medicine, Carmichael Medical College, Calcutta, and honorary professor of bio-chemistry, University of Calcutta; (11) Veterinary Research, Sir Arthur Olver, animal husbandry expert, Imperial Council of Agricultural Research, New Delhi; (12) Physiology, Col. R. N. Chopra, officiating director and professor of pharmacology, School of Tropical Medicine, Calcutta; (13) Psychology, Dr. G. Bose, University College of Science, 92 Upper Circular Road, Calcutta. The main part of the British Association delegation will arrive at Bombay on December 16, and will tour Northern India before attending the Congress. The address of the General Secretary of the Indian Science Congress Association is c/o The Geological Survey of India, 27 Chowringhee, Calcutta.

Lubrication and Lubricants

THE *Journal of the Institution of Mechanical Engineers* of May describes the arrangements which have been made for a general discussion on lubrication and lubricants which is to take place at the Institution on October 13-15. The executive committee, with Dr. H. J. Gough as chairman, desires to make this an opportunity to review the present state of knowledge on the subject by means of contributions from those who are especially qualified to discuss the major problems, the immediate objects being to establish a correlation between theory, academic research and trade practice, to elucidate the methods of design of bearings, to obtain current views upon bearing metals and to explore the significance of laboratory tests. In connexion with the meetings, it is proposed to organize an exhibition. In view of the importance of the subject, the active co-operation of other societies has been invited and already more than forty British and foreign institutions have accepted. The programme, in its present state, contains about a hundred papers divided into four distinct groups dealing respectively with journal and thrust bearings, engine lubrication, industrial applications, and properties and testing, each of which has been split up into appropriate sections and subsections. From these it would appear that no aspect of the widespread applications of lubrication has been lost sight of, and besides those problems and considerations associated with all classes of machinery, such cases as those arising in connexion with wiredrawing, wire rope transmission, chains, metal pressings, cutting fluids and the like are to be subjects of discussion. In the group comprising properties and testing, the papers will deal with three main sections under the headings friction and wear, physical properties, and chemical properties. The papers already promised are being prepared by leading authorities on their subjects, and it is desired that further offers to contribute to the discussion should be addressed to the secretary, The Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

Sphinx

THE problem of publishing results too specialized for such a journal as NATURE and not substantial enough for the proceedings of a learned society, which nevertheless have some permanent value and deserve to be recorded, is difficult. Many a pertinent observation must be buried in field-club notes in the files of local weeklies, and a glance at the pages of Dickson's "History of the Theory of Numbers" will suggest the magnitude of the task of the conscientious historian in any subject in which isolated statements can be significant. These remarks are prompted by the appearance recently in *Sphinx*, a monthly devoted to mathematical recreations and published privately by M. Kraitchik, Institut des Hautes Etudes de Belgique, 65 rue de la Concorde, Bruxelles, of an article "On Hyper-Exponential Numbers", in which Mr. H. J. Woodall, formerly associated with Lieut.-Colonel Cunningham in a series of extensive computations, discusses some sequences which resemble the sequence of functions forming the exponential scale but replace the *e* of the analyst by an integer. Mr. Woodall gives specimens of classification, determines a few orders of magnitude, and finds a few inequalities. No better medium of publication exists for such work, but the fact remains that a future investigator is much more likely to repeat Mr. Woodall's calculations than to discover that the work has been done.

Bleaching of Wood-pulp

IN connexion with the article on "Wood Pulp and the Future" (see NATURE, 139, 867, May 22, 1937) we have received a letter from the Development and Research Department of the Pennsylvania Salt Manufacturing Co., 1000 Widener Building, Philadelphia, pointing out that the use of an emulsion of chlorine in water in multi-stage bleaching processes is the result of investigations made by this Company and is patented in twelve countries. It may be stated that the writer of the article was fully aware of the part played by the organization concerned in developing this particular method of bleaching. In a short survey covering such a wide field, however, it was not considered necessary to give references to the work of individual firms; in the case of bleaching processes in fact, this would indeed have been a particularly difficult matter, owing to the large number involved.

Genetical Society

THE summer meeting of the Genetical Society was held at the Courtauld Genetical Laboratory, Inner Circle, Regent's Park, on August 10. The demonstrations shown by Prof. R. Ruggles Gates and his staff included the following: many new species and varieties of *Œnothera*, in connexion with the genetic survey of the genus in eastern Canada; Indian and Japanese varieties of rice, with X-ray mutations, autotriploid and allotriploid progenies, showing an inverse relation between the number of extra chromosomes and the size of the plants; a cytological survey of various species of the Phalarideæ; cytogenetical studies of *Cicer arietinum*; experiments with the growth of pollen tubes in cotton plants, and a chromosome survey of various Malvaceæ.

Research on Mental Disease

THE annual report for 1936-37 of the Birmingham Joint Board of Research for Mental Disease consists entirely of pathological laboratory findings. Fifty-six named varieties of micro-organism are described as occurring in the cavities or excretion of insane subjects and 769 tests were made of serological agglutination, though the absence of any record of control investigation among the sane population leaves the reader in difficulty as to the precise value of these results. The Board apparently does not concern itself with the psychological approach to the study of mental disease.

New Comet 1937 g (Hubble)

DR. E. P. HUBBLE, at Mount Wilson, discovered a new comet of magnitude 13 on August 4. Its position was R.A. $22^h\ 49{\cdot}3^m$, S. Decl. 21°, and its daily motion -30^s in R.A. and 6′ S. in Decl. Later observations have been made, but there is no mention of the positions, except one from Bergedorf. Cunningham and Shapley have computed the following orbit :

$$\begin{array}{lll} T & \text{1937 Dec. 11.56 U.T.} & \\ \omega & 54^\circ\ \ 54' & \multirow{2}{*}{\Big\}\ 1937{\cdot}0} \\ \Omega & 11\ \ \ 12 & \\ i & 9\ \ \ 53 & \\ q & 0{\cdot}9010 & \end{array}$$

Its position in the constellation of Aquarius is not very favourable for observation in northern latitudes, and although it is approaching both the earth and the sun and will increase in brightness, it is not likely to become a conspicuous object. Its distances from the earth and sun at present are 1·1 and 2·1 units respectively, and on September 20 these will be 0·75 and 1·7 respectively.

Announcements

THE President of the French Republic has conferred the honour of La Croix de Chevalier de la Légion d'Honneur on Mr. Geo. E. Pearson, the governing director of the Wellcome Foundation, Ltd.

THE following appointments and promotions have recently been made in the Colonial Service : G. L. Carson, assistant conservator of forests, Malaya ; W. P. Gaskell, inspector of mines, Nigeria ; I. G. John, meteorological officer, Survey Department, Malaya ; F. Birkinshaw (State agricultural officer, Perak), chief field officer, Agricultural Department, Malaya ; W. G. Leckie (agricultural officer), senior agricultural officer, Kenya ; J. N. Milsum (agriculturist), senior agricultural officer, Malaya ; W. L. Watt (agricultural officer), senior agricultural officer, Kenya ; M. E. Dommen (assistant conservator of forests, Cyprus), assistant conservator of forests, Nigeria ; S. T. Phillips (inspector of plants and produce), senior inspector of plants and produce, Gold Coast ; S. A. Roach (industrial instructor, Education Department, Tanganyika), livestock officer, Department of Agriculture, Sierra Leone ; E. Wall (executive engineer, Public Works Department, Nyasaland), senior executive engineer, Public Works Department, Nigeria.

DR. THORVALD MADSEN, chief of the State Serum Institute of Copenhagen, has for the seventh time been elected president of the Health Committee of the League of Nations.

MR. FIORELLA H. LA GUARDIA, Mayor of New York City, recently laid the corner stone of a new health centre in New York, forming the ninth building which had been started under the plan of the New York City Department of Health to create full-time health districts.

AN international Congress of Tourism, Thermalism and Climatism will be held in Paris on October 14–17. Further information can be obtained from the Secrétariat Général de la Fédération thermale et climatique française, 127 Avenue des Champs Elysées, Paris VIIIe.

THE twenty-first International Congress against Alcoholism will be held in Warsaw on September 12–17 under the patronage of the President of the Polish Republic, with Dr. Chodzko, formerly Minister of Public Health, as president of the executive committee. The following papers, among others, will be read : "The Influence of Alcohol on the Brain", by Prof. Rose, of Wilno ; "Wine as a Factor in Alcoholism", by Drs. Dauphin, Fillion-Roux and Faisant (France) ; and "Alcohol and Mental Disease with Special Reference to Beer as a Cause of Alcoholism", by Prof. Vermeylen of Brussels. Further information can be obtained from Dr. R. Hercod, La Glycine, Epinettes, Lausanne.

MESSRS. BOOTS have issued a booklet dealing shortly with the use of protamine insulin (with zinc). It has a much more prolonged action than ordinary insulin, and is therefore more convenient to use. The booklet contains fourteen references to original papers, and may be obtained on application to the Wholesale and Export Department, Station Street, Nottingham.

"ZOOLOGIA SPECIALIS" is the title of a book catalogue (No. 711) issued by Gustav Fock (Leipzig), containing, amongst other items, books and papers from the libraries of the late Prof. G. Grimpe of Leipzig and of Prof. L. Plate of Jena. The catalogue details 5,737 items, amongst which Vermes, Mollusca, Crustacea, Aves, Mammalia and scientific periodicals are especially well represented.

A SMALL book entitled "Clinical Colorimetry with the Pulfrich Photometer", compiled and published by Carl Zeiss, of Jena, in collaboration with Dr. W. Krebs (London : Carl Zeiss (London), Ltd. ; W. and G. Foyle. 7*s*. 6*d*. net), gives details of a number of colorimetric tests applicable to clinical material. The technique of these tests is adapted for use with the Pulfrich stufenphotometer made by Messrs. Carl Zeiss. It will probably prove very useful to clinical pathologists.

ERRATUM.—In the fifth line from the bottom of the first column of p. 23 of NATURE of July 3, 1937, the names "Millikan and Cameron" should be replaced by "Bethe and Heitler". Millikan and Cameron have advanced no theory of showers.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 324.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

World-wide Effect in Cosmic Ray Intensity, as Observed during a Recent Magnetic Storm

MR. S. E. FORBUSH[1] noted a very striking similarity between the variation of the horizontal component of the earth's magnetic field intensity and of the intensity of the cosmic ray ionization (as registered by two Compton cosmic ray meters) at Cheltenham, Maryland, U.S.A., and Huancayo, Peru, during the very severe magnetic disturbances between April 25 and April 30 of this year.

Our cosmic ray research station on the Hafelekar (2,300 metres above sea-level, near Innsbruck, Austria) gave results which corroborate Mr. Forbush's statements very strikingly. The magnetogram was taken from the registrations of the Vienna-Auhof Terrestrial Magnetic Station. We are obliged to Dr. M. Kofler, acting director of the Meteorologische Zentralanstalt, of Vienna, for placing the hourly values of the horizontal magnetic intensity at our disposal.

In Fig. 1 these values reduced to Greenwich Mean Time are plotted (thin curve) together with the bi-hourly means of the cosmic ray ionization on the Hafelekar, as registered with our Steinke standard apparatus shielded on all sides by lead (10 cm. thick) and in addition by iron plates (7 cm. thick). All values were reduced to standard pressure.

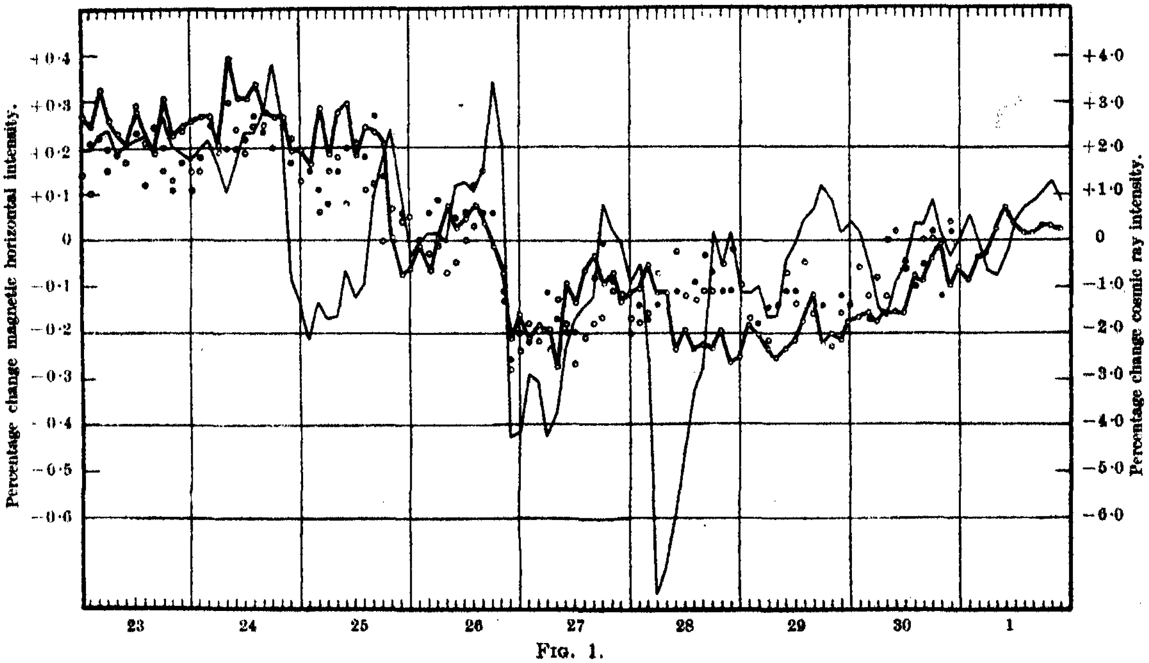

FIG. 1.

BI-HOURLY MEAN VALUES OF COSMIC RAY INTENSITY AND OF MAGNETIC HORIZONTAL INTENSITY, APRIL 23 TO MAY 1, 1937.

●, Cosmic ray intensity, Huancayo. ο, Cosmic ray intensity, Cheltenham. ο—ο—ο, Cosmic ray intensity, Hafelekar.

The variations of the ionization observed during the magnetically disturbed days (April 24–30, 1937) were uncommonly large: the maximum of the bi-hourly ionization means was 2,485 *J.* (April 24), the minimum 2,339 *J.*, the deviations from the total average being + 3·9 and − 2·8 per cent respectively. Even the daily mean values varied by as much as + 2·7 per cent (April 24) and − 2·2 per cent (April 29).

In Fig. 1 the heavy-lined curve indicates our bi-hourly ionization values; the corresponding values of Cheltenham and Huancayo, indicated by small dots and circles in Fig. 1, were taken from Mr. Forbush's paper cited above.

The general trend of the curves of these two stations is in beautiful agreement with our curve. The magnetic intensity curve from Vienna-Auhof is nearly identical with the curve of the two American stations.

In Fig. 2 the daily mean values of the horizontal intensity are plotted together with the cosmic ray ionization and with the number of triple coincidences as observed by L. Jaeger on the Hafelekar with two sets of Geiger-Müller counters, consisting each of three counters placed vertically above each other. Here once more the close similarity in the variation of the cosmic ray intensity and the horizontal magnetic force during the magnetic storm is clearly demonstrated.

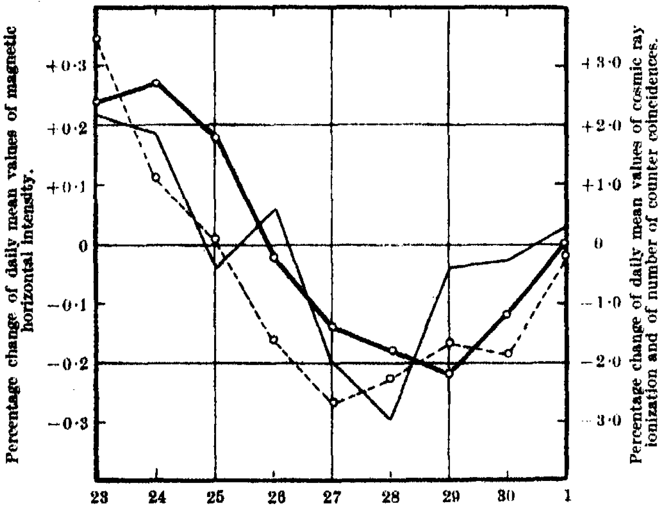

Fig. 2.

DAILY MEAN VALUES OF COSMIC RAY IONIZATION, OF NUMBER OF COUNTER COINCIDENCES AND OF MAGNETIC HORIZONTAL INTENSITY, APRIL 23 TO MAY 1, 1937. o—o—o, COSMIC RAY IONIZATION; o- -o- -o, NUMBER OF COUNTER COINCIDENCES; ———, MAGNETIC HORIZONTAL INTENSITY.

We think that Forbush's results taken together with our own results prove: (1) that cosmic ray ionization was influenced all over the earth by the magnetic disturbances between April 24 and 30 of this year and that a decrease of the cosmic ray intensity followed a decrease of the magnetic intensity; (2) that the magnitude of the variations of the cosmic ray intensity during magnetically disturbed days may amount to as much as ± 3 per cent; (3) that these variations occurred simultaneously all over our planet. We agree with Mr. Forbush in concluding that the study of the magnetic storm effects will give valuable information on the energy spectrum of the cosmic radiation.

A detailed analysis of the magnetic effects on cosmic ray ionization during one whole year (1936–37) will be published later in *Terrestrial Magnetism and Atmospheric Electricity*.

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July 17.

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[1] *Phys. Rev.*, 51, 1108 (1937).

Concentration of Mesothorium-I by Duckweed (*Lemna*)

IT is characteristic of the waters of the earth's crust—among which we can distinguish more than 550 different mineralogical species—that all these chemically different water-solutions constitute theoretically one and the same natural body—a unique great water-equilibrium of the earth's crust[1]. They are in constant close material connexion. This connexion is produced by two physical equilibrium systems common to all natural water-solutions:

Water⇌water vapours (in contact with gaseous atmospheres).
Water⇌pellicular water (in contact with solids).

The solid substance of the earth's crust is penetrated by pellicular water-solutions[2]. It is characteristic that there are chemical elements which do not enter into the constitution of these solutions[3]. Among these elements one, on account of its great geochemical and geological importance, must be studied with the greatest attention, namely, thorium. Two deductions can be made from this characteristic of thorium atoms in the geochemical history of thorium:

(1) In relation to the content of thorium atoms in sea-water[4]: either not thorium atoms, but the products of their disintegration—mesothorium-I, radio-thorium, and thorium-*X*—are present in sea-water, or the thorium atoms are included in the dispersed solid particles distributed in sea-water.

(2) In relation to the thorium content of living organisms: thorium atoms should not be found in the living organisms, which obtain all their metallic atoms from water-solutions, soil-solutions and surface or underground waters.

To verify the second deduction, researches were carried out by B. Brunowsky and C. Kunasheva in the Biogeochemical Laboratory of the Academy of Sciences, Moscow, which proved its truth. A large quantity of duckweed belonging to two species, *Lemna minor* L. and *Lemna polyrrhiza* L., was collected in 1933 from the Orangery Pond at Peterhof (near Leningrad), and a 200-litre sample of water taken. The plant mass was divided into two lots. The first lot (30·4 kgm. live weight) was dissolved, and the isotopes of radium and thorium separated in the solution by ammonia. The fraction of the solution containing radium isotopes was examined after two years by way of Tn for its mesothorium content, which proved to be $(10 \cdot 3 \pm 0 \cdot 3) \times 10^{-15}$ per cent. A month after the separation, in the fraction containing thorium isotopes, the thorium-*X* was precipitated by barium sulphate, and the quantity of radio-thorium evaluated by determination of Tn. The radiothorium content of *Lemna* proved to be exactly such as should have generated in *Lemna* from mesothorium-I during the period of time between the taking of samples and the separation of the isotopes.

In 1935, the second lot of *Lemna*, which had been preserved in an air-dry condition for two years, was dissolved and the Tn content determined. The calculation of the mesothorium-I content of *Lemna* was then made on the basis of the observed ionization effect, taking into account the possibility of thorium atoms being either absent or present. In the first case, the content was calculated to be $10{\cdot}2 \times 10^{-15}$ per cent, and in the second $9{\cdot}05 \times 10^{-15}$ per cent. These results, compared with the mesothorium-I content given above for the radium isotope solution, which certainly contained no thorium atoms, led to the conclusion that the thorium content of *Lemna* does not exceed 1 per cent of the quantity in equilibrium with mesothorium-I, that is, that *Lemna* does not contain isotopes of thorium.

Analogous tests of the pond water proved the presence in it of $8{\cdot}25 \times 10^{-17}$ per cent of mesothorium-I, and not exceeding 20 per cent of the radio-thorium for equilibrium with the mesothorium-I. This suggests that, although isotopes of thorium are present in water, they are not assimilated by *Lemna*. On the other hand, *Lemna* accumulates mesothorium-I and concentrates it a hundredfold as compared with its content in the water. The plant, therefore, assimilates radioactive elements, if present in the nutrient medium, in strict accordance with their chemical properties.

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B. K. BRUNOWSKY.
C. G. KUNASHEVA.

Biogeochemical Laboratory,
Academy of Science of the U.S.S.R.,
Moscow.
May 12.

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[1] Vernadsky, W. I., "History of Natural Waters" (in Russian), **1**, (1933-36).

[2] Vernadsky, W. I., *ibid.* **1**, 11-12.

[3] Vernadsky, W. I., *Priroda* (in Russian), No. 8-9, 20 (1933).

[4] Vernadsky, W. I., *Priroda* (in Russian), No. 5, 414 (1932).

Histological Changes produced by Castration and by Sex Hormones in the Adrenals of Normal and of Castrated Male Rats

IN our previous publications[1] we have shown that in male rats after castration the weight of the adrenals increases and that this 'castration hypertrophy' decreases or disappears after injections of androsterone, androstanediol, dehydroandrosterone, testosterone, testosterone propionate, androstenediol and androstenedione. In the present communication the results of histological examination of these adrenals are given.

The occurrence of 'castration hypertrophy' in the adrenals of male rats has been observed previously. The effect of injections of some of the hormones mentioned above has been studied only on the *X*-zone of castrated mice[2,3].

The hypertrophy of the 'castration' adrenal is due to the hypertrophy of the zona fasciculata and reticularis, especially the latter, resulting chiefly from a considerable increase in the size of the cells composing these layers. The lipoid content of the outer half of the zona fasciculata is definitely increased while that of the reticularis is decreased.

The 'demarcation zone' lies between the glomerulosa and fasciculata zones, and consists of 1–4 rows of cells, in which lipoid granules are normally few or absent; after castration it becomes impregnated with lipoid and hence appears to be absent.

The width of the zones and size of the cells return to normal or nearly normal size if sufficiently large doses of sex hormones are injected into castrated rats. Moreover, some hormones may decrease to below normal both the zones and the size of the cells (androsterone and androstanediol).

Vacuolation, which is slightly increased in the zona fasciculata after castration, is decreased after injections of sex hormones, sometimes in a most striking degree, almost disappearing with high doses of androsterone. Testosterone presents a special case; small doses decrease vacuolation, but after high doses (1400 γ) it appears again.

Most doses and hormones investigated produced in all zones, in some cases excluding the glomerulosa, a partial, sometimes nearly complete, disappearance of lipoid granules. The discrepancy between the very pronounced vacuolation and greatly decreased number of lipoid granules, as shown by Sharlach R staining, was most striking after injections of 1400 γ of testosterone, and somewhat less so with testosterone propionate.

The demarcation zone, apparently absent in castrated animals, appeared again in the injected rats.

The effect of a resting period of nine days after *testosterone propionate injections (group 2)* was examined by comparing the adrenals of these rats with those of their litter mates killed the day after the last injection (group 1). The following striking difference was noted. In both groups the width of the zones and the size of the cells were reduced to the normal condition. The number of lipoid granules, however, was abnormally low in group 1 (usual effect of the injection), but returned to normal in group 2. Thus a complete return to normal was obtained in the adrenals approximately nine days after the last injection.

Injections of testosterone propionate into normal rats greatly decreased both the number of lipoid granules in the cortex (especially with 1500 γ) and the vacuolation of the fasciculata cells, and caused an increase in the number of faintly stained nuclei with a poor chromatin network.

K. HALL.
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July 14.

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[1] Korenchevsky and co-workers, NATURE, **135**, 434; **136**, 185 (1935); **137**, 494 (1936). *Biochem. J.*, **29**, 2534; **30**, 558 and 1514 (1936); **31**, 467, 475 and 780 (1937).

[2] Cramer and Horning, *Lancet*, 1, 1330 (1937).

[3] Deanesly and Parkes, *Quart. J. Physiol.*, **26**, 393 (1937).

Prevention of Assimilation in Respiring Cells

UNTIL recently it was generally assumed that so-called 'resting' cells, suspended in a buffer solution in the presence of a nitrogen-free substrate, could be employed in studying respiration separately from other metabolic processes. Some doubt as to the validity of this assumption is suggested by the studies of Cook and Stephenson[1], which show that the oxygen consumed during the oxidation of glucose, lactate or acetate by *Bact. coli* amounts to only from two thirds to three fourths of that required for complete oxidation.

Barker[2] advanced considerable evidence that this incomplete oxidation may be due to an oxidative assimilation, which in the case of the oxidation of acetate by the colourless alga *Prototheca Zopfii* may be represented as

$$CH_3COOH + O_2 \rightarrow CO_2 + H_2O + (HCHO).$$

Barker also reported that the amount of carbon assimilated varies with the nature of the substrate. Giesberger[3] also observed this phenomenon with different species of *Spirillum* and showed, moreover, that the amount of carbon assimilated from a given substrate varies with the different species.

The fact that this intimate relation between respiration and assimilation is encountered in such widely different groups of organisms makes it probable that the phenomenon is of a quite general nature. It seemed, therefore, of importance to investigate whether respiration and assimilation are indeed intimately associated in one reaction chain as suggested by the equations advanced by Barker and Giesberger, or whether it is possible to block one process and not the other.

In the course of investigations (Warburg technique) on the oxidative metabolism of washed suspensions of *Pseudomonas calco-acetica* Beijerinck in phosphate buffer of *p*H 7·1, it was observed that the oxygen consumed during the oxidation of acetate or of butyrate amounted to only approximately three fourths of that required for complete oxidation.

It has now been observed that suitable concentrations of sodium azide (*M*/600) or 2 : 4-dinitrophenol (*M*/4000) block the assimilatory process and bring about a complete oxidation of the substrates, the rate of respiration being in general only slightly decreased. Higher concentrations of the poisons markedly reduced the rate of respiration also.

In the case of acetate this change in metabolism is not accompanied by any change in the respiratory quotient, since in the absence of the poison its value is also approximately 1·0, the conversion of the acetate apparently proceeding according to the equation

$$2CH_3COOH + 3O_2 \rightarrow 3CO_2 + 3H_2O + (HCHO).$$

The oxidation of butyrate, however, presents another picture, as under normal conditions the respiratory quotient was approximately 0·68, suggesting that the reaction may be represented as

$$2C_4H_8O_2 + 7O_2 \rightarrow 5CO_2 + 5H_2O + 3(HCHO).$$

In the presence of the azide or dinitrophenol the observed respiratory quotient was 0·8, the value characteristic of the complete oxidation of butyrate.

The oxidation of acetate by *Bact. coli* proceeds in a manner similar to that described for *Ps. calco-acetica*, and assimilation is also blocked by the same poisons. It was observed that *M*/4000 dinitrophenol tended to stimulate respiration to a slight extent while at the same time the oxidation proceeded to completion.

The observations suggest that it is indeed possible to block the assimilatory process in non-proliferating cells by the addition of critical concentrations of certain chemical agents, thus permitting the oxidation of a given substrate to proceed to completion at an almost normal rate. These observations also suggest that the so-called 'slimming' agents such as 2 : 4-dinitrophenol may exert their weight-reducing action in man by a suppression of assimilation, rather than simply by their stimulatory effect on respiration.

Full details will soon be published elsewhere.

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Nutritional Value of Some Indian Diets

MCCARRISON[1] has pointed out the great superiority of northern Indian diets as compared with those consumed in the east and south of India. It appeared to us to be of interest to compare the northern Indian well-to-do and poor Hindu diets, the ingredients of which he has listed[2], by feeding them to rats.

The diets were found to contain calcium and phosphorus in the following amounts :

TABLE 1.

	Ca (per cent)	P (per cent)	Ca : P ratio
Northern Indian	0·17	0·33	0·52
	0·18	0·37	0·49
Well-to-do Hindu	0·09	0·22	0·42
	0·09	0·21	0·43
Poor Hindu	0·018	0·08	0·23
	0·021	0·11	0·20

It will be noted that all three diets are low in Ca and P, and especially the poor Hindu diet, which has a rachitogenic Ca : P ratio.

Groups of 8 rats were fed on these diets, group *A* being fed on the northern Indian diet and *B* and *C* on the well-to-do and poor Hindu diets respectively. The diets were fed uncooked. The mortality in groups *A* and *B* was *nil*, but of those in group *C*, six died of pneumonia and none survived more than 105 days. The rate of growth of group *A* was about 2 gm./day, of group *B* about 1·4 gm./day and of group *C* about 0·9 gm./day. In the case of rats on stock diet, this is about 2·7 gm./day.

Rats were killed at intervals and the ash content determined in the lower incisors, one femur, tibia and fibula. The figures for bone ash at 105 days of age, which are typical of all the values obtained, are given below, together with figures from control rats on the Rowett Institute stock diet.

TABLE 2.

ASH CONTENT OF BONES.

Age (days)	*A*	*B*	*C*	Control
105	50·8	42·0	31·0	63·3

These values show that calcification was impaired in all three groups, compared with the controls, and especially so in group *C*. Changes in the same direction, but of smaller degree, were found in the teeth. This is in accordance with the well-known fact that the composition of the teeth is not so readily altered by dietary means as is that of the bones.

The width of the predentin in the upper incisor teeth was measured, the following average values being obtained :

A	*B*	*C*	Control
25µ	21µ	51µ	18µ

The normal value is about 16 µ and is increased when calcification is poor ; these values therefore indicate that the calcification of the teeth was impaired in all three groups compared with the controls, and especially so in group *C*. In groups *A* and *B*, the incidence of interglobular dentin was higher than normal. In group *C*, the dentin contained a great many interglobular spaces and also showed a high degree of stratification ; the predentin in this group had many vascular inclusions.

In breeding, all three groups were definitely inferior to normal rats on stock diet. Group *C* did not breed at all. Group *A* mated at the normal time, but the litter weights, weaning weights and number of young surviving to weaning were low. Group *B* showed the same poor reproductive performance and in addition the mating date was much retarded.

Although the number of rats used was small, the results confirm McCarrison's finding that the northern Indian diet is superior to both the Hindu diets. The poor Hindu diet is defective on all points; and it is of interest to note that, judged by modern standards, the northern Indian diet is further capable of improvement.

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[1] McCarrison, *Nut. Abst. Rev.*, 2, 3 (1932-33).

[2] McCarrison, "Food", pp. 113-115 (Madras, 1931).

Solubility of Silica Dusts

THE industrial disease of silicosis has been postulated to have a relation to the dissolution of particles of mineral silicates in the lung. Whether this 'solubility theory' of silicosis be true, considerable interest is attached to the production of soluble silica from finely divided mineral dusts. The amount of silicic acid which a mineral form of silica will yield in solution is exceedingly small when it is present as crystals or as coarse fragments. But if it be reduced to a particle size of the order of the dust in the air (that is, < 1 to 10 microns) then the dissolution rate becomes appreciable.

In a recent paper, Emmons and Wilcox[1] gave figures for the silica dissolved from a number of mineral silicates. The method adopted in the study of the dissolution of these dusts is open to grave criticism. For the separation of the liquid phase (blood serum) from the solid (the powdered mineral) these workers relied on centrifugalization at 3,500 r.p.m. for fifteen minutes: the dusts having been exposed to the serum for two months at 37°. The total amount of silica in the supernatant fluid was determined by ashing an aliquot, following by gravimetric analysis.

The rate of sedimentation of particles depends on their shape; a roughly spherical particle tends to settle more quickly than a fibrous particle, even though the particles be of approximately the same size. Centrifugalization at the modest speed of 3,500 r.p.m. for fifteen minutes will not completely remove fine particles of the size (1–10 μ) used by Emmons and Wilcox—particularly from a viscous fluid like blood serum; and the extent to which they are removed will depend on the particle shape. It is notable that the figures showing the greatest percentage of silica dissolved are for fibrous minerals. Thus, in the results for human blood serum, sericite and asbestos give a much greater apparent 'solubility' than opal, quartz or cristabolite. In some cases, for example, that of quartz, which sediments rapidly, the results may approximate to the true solubility figure, but in others where the rate of sedimentation is low they are probably greatly in excess. If the results are expressed in terms of the mgm. SiO_2 contained in 100 c.c. of solution, then figures of 5·0 and 3·8 are found for quartz, a solubility figure in reasonable agreement with other published data. But the figures found for sericite, namely, 14·3 and 9·2, are very much higher than other recorded results. It is suggested that these results do not, in fact, represent the silicic acid in solution; they represent the total amount of silica left in suspension, plus what small amount may be in solution. Only by high-speed centrifugalization, for example, 15,000 r.p.m. for forty-five minutes, is it possible completely to remove these particles from suspension.

A true measure of the amount of silicic acid which has gone into solution from a powdered mineral can be gained in two ways. The suspended material can be completely separated from the soluble, and the total silica in the separated liquid determined by gravimetric analysis; or secondly, advantage can be taken of the fact that in certain chemical reactions only the silica present as silicic acid will take part. Such a reaction is represented by the well-known formation of silico-molybdic acid, a substance which imparts an intense yellow colour to its aqueous solution even when it is present only in minute amount.

Powdered amorphous or crystalline silica when freshly suspended in water gives no colour on the addition of molybdic acid, but does so after it has stood in contact with the water for some hours, that is, when some of the silica has passed into solution as silicic acid. The measurement of the intensity of the yellow colour (or of the blue colour in a refinement of the method where the silico-molybdic acid is reduced to a blue complex) furnishes a means by which the amount of silicic acid in solution can be estimated, the maximum part of the suspended material having been removed by filtration through very fine paper. Results obtained by this type of procedure probably show fairly accurately the actual soluble silica content of the solution. Such results will vary, of course, with the concentration of the dust and its degree of fineness, as well as with the type of mineral and liquid used. In the accompanying table are presented figures which are believed substantially to represent the rate at which silicic acid will pass into solution from a powdered mineral of a certain range of particle size when suspended at a given concentration in a liquid.

DISSOLUTION OF MINERAL DUSTS

(mgm. SiO_2 dissolved by 100 c.c. of liquid)

(1) 0·1 gm. of dust in 100 c.c. of 1 per cent sodium bicarbonate				
Days at 37°	Quartz		Sericite	
	20–40 μ	< 1–5 μ	Plate*	Fibrous*
1	0·71	0·70	0·32	0·51
3	0·97	1·65	0·39	0·57
5	1·02	2·08	0·32	0·62
8	1·20	2·74	0·46	0·78
Hours at 100°				
2	1·25	2·05	0·30	0·37
4	1·46	4·15	0·40	0·39
6	2·02	4·37	0·42	0·39
(2) 2 gm. dust in 100 c.c. acetic fluid at 37°				
Days	Ppt'd. silica	Quartz	Kaolin	Mica
4	7·04	4·53	0·22	—
8	7·12	5·91	0·26	1·0
16		5·82	0·24	1·8

* Plates of sericite < 1–2·5 μ (few larger); fibres of sericite 1–10 μ in length by about 0·1–1 μ in width.

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Synthesis of Benzanthrones

IN a recent publication by one of us[1], it was shown that the readily formed $\alpha\gamma$-diethylethers of β-substituted glycerols could be used to prepare 2-substituted quinolines. We have now used these ethers for the synthesis of 2-alkyl- and 2-arylbenzanthrones under the conditions of Bally and Scholl's synthesis[2], the mechanism of which is being further investigated.

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[1] *J. Chem. Soc.*, 1366 (1936).

[2] *Ber.*, **44**, 1665 (1911).

Propagation of Optical Contact

IT is not generally known that by a simple device so-called optical contact can propagate itself.

Contact is usually produced by the application of considerable pressure, first on the centre of the plate and thereafter in a spiral path outwardly to the periphery. If, however, the test plate is pierced by a small hole and pressure is applied at one point and then withdrawn, the surfaces, without further manipulation, will move together into optical contact.

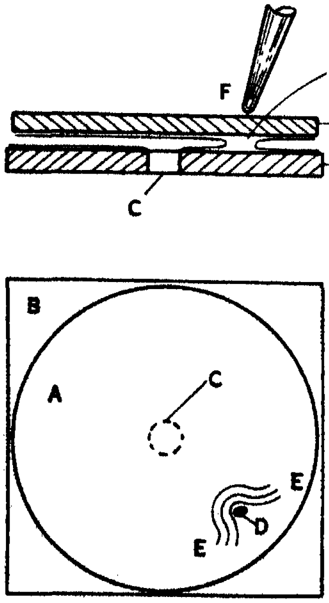

FIG. 1.

In Fig. 1, *A* is an optically polished glass disk, lying upon a test plate *B*, pierced by a hole *C*. Pressure is applied, say, at *F*, and then withdrawn. The Newton rings around the point, without further assistance, expand and disappear, leaving the surfaces in pseudo-contact and in darkness devoid of colours. A small speck of dust, such as *D*, will not arrest the movement. It is interesting to observe the rings at *E* attempting to encircle the speck and ultimately doing so, leaving around it two small bluish white rings, separated by a mottled dark one. These white rings suggest the following explanation of the phenomenon under consideration.

Optically polished glass surfaces, unless they are specially treated, have surface layers of something akin to grease. Pressure at *F* bends the plate *A* sufficiently to join the grease films, as at *G*. Surface tension forces around *G* expel the air and extend the liquid continuity over the whole surface. Light falling upon the area *G* passes through more or less completely, according to the equality of the refractive indices of the grease and glass. Viewed from above, the liquid region *G* appears dark and, from below, bright.

Light is reflected from the rounded surface tension contours, which regions appear bluish white. Newton rings may appear in the remainder of the area. From measurements made by Sir Isaac Newton, I reckon the thickness of each grease layer to be less than one millionth of an inch.

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Reversible Bleaching of Chlorophyll

CHLOROPHYLL solutions bleach slowly in light. This has been attributed to a reaction with dissolved oxygen[1]. For the quantum yield of this bleaching we found, in methyl alcohol solutions, values about $\gamma = 10^{-6}$, independent of oxygen concentration over a wide range, but disappearing upon a complete removal of oxygen from the solution.

In oxygen-free solutions, a *reversible* bleaching is observed instead of the above-mentioned irreversible one—that is, the extinction coefficient of the solution returns to its original value as soon as the illumination has ceased. When a solution containing 10^{-4} mol. chlorophyll per litre of methyl alcohol is illuminated with red light, of an intensity corresponding to the absorption of 10 quanta per sec. by each molecule, the extinction coefficient of this solution for red light is decreased—it is about 1 per cent less than in the dark. (A method of measuring effects of this order of magnitude was described previously[2].) This means $\tau \times \gamma = 10^{-3}$ (τ = mean 'life-time' of the bleached state). Since $\tau \leq 1$ sec. (because of the velocity with which the original state is re-established in the dark), γ is $\geqslant 10^{-3}$. More probably, $\gamma \simeq 1$, and $\tau = 10^{-3}$ sec. The quantum yield of the reversible bleaching is in any case much higher than that of the irreversible oxidation in presence of oxygen.

The reversible bleaching is proportional to the *square root of light intensity*. It is thus due to a recombination of the products formed by the photochemical dissociation of chlorophyll. The nearest assumption is that chlorophyll dissociates into a 'dehydrochlorophyll' and an H-atom. A life-time of 10^{-3} sec. is what one would expect for this kind of dissociation, if the recombination occurs by the first encounter of the dissociation products.

In a few experiments, under apparently unchanged conditions, *much stronger—but still perfectly reversible—bleaching effects were observed, rising to 50 per cent.* We may suppose them to be due to the presence of some unknown impurity 'stabilizing' the dissociated state—for example, by a temporary 'absorption' of the H-atom. In search of substances which may produce such an effect, we found that *formic acid* causes a considerable increase in the reversible bleaching of chlorophyll solutions (of the order of

10 per cent under the above-mentioned conditions). This is interesting in connexion with the assimilation process.

All reversible effects, even the strongest ones, are suppressed by traces of oxygen, and restored again by a removal of oxygen from the solution. 5×10^{-4} mol. oxygen per litre are sufficient to reduce by 50 per cent the bleaching observed in presence of formic acid. Oxygen either forms with chlorophyll a complex which prevents the dissociation of the chlorophyll molecule by light[3], or it takes away the energy of excited chlorophyll molecules by collisions, before they have had time to dissociate[4].

All reversible bleaching effects are also suppressed by *ferrous chloride*. This points to a relation between the above-described 'optical' bleaching and the reversible 'chemical' bleaching of chlorophyll by ferric salts[5]. In presence of ferric salts, chlorophyll is reversibly bleached by light even without the removal of oxygen. Fe^{3+} ions either are able to take an H-atom (or an electron) from an excited chlorophyll molecule despite its protection by an O_2 complex; or, alternatively, they react with excited chlorophyll molecules before these have had time to lose their excitation energy by collisions with oxygen.

Most of the above-described experiments were carried out with synthetic ethyl chlorophyllide *a*, kindly supplied by Prof. H. Fischer (Munich). The same effects were, however, also observed with the natural chlorophylls *a* and *b* which Prof. A. Stoll (Basle) has kindly put at our disposal. Our heartiest thanks are due to Prof. F. G. Donnan for his interest in this work and the hospitality of his laboratory.

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[1] Wurmser, R., *Arch. Phys. Biol.*, 1, Nr. 3 (1921). See, however Knorr, H. V., and Albers, V. M., Cold Spring Harbor Symposia of Quantitative Biology, 3, 87, 98 (1936).

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Transitive Interference in Gene Linkage

MORGAN'S hypothesis of interference has been subjected[1] to treatment in terms of the probability of non-independent events, as the probability of a double break is not equal to the product of the probabilities of the two single breaks. The f-values, that is, the experimental values of the freedom of exchange between two genes (recombination per cent in decimals) are thus substituted by the calculated—and greater—primary $\mathfrak{f}$-values, which would be manifest if the first break did not interfere with the occurrence of a later break. The $\mathfrak{i}$-values measuring the strength of interference are obtained at the same time as the frequencies of the expected double breaks suppressed by interference. The sum of the $\mathfrak{f}$-values between neighbouring genes yields the primary map-distance $\mathfrak{M}$ on the primary map. The calculations are carried out with each interval taken as leading, that is, the interval in which the whole process of interference (the twisting of the chromosomes) starts. The real leading interval is the one which leads to simple relations between $\mathfrak{i}$ and $\mathfrak{M}$.

The application of this theory to the seven point experiment "Xple" of Bridges and Olbrycht[2] showed the *X*-chromosome of *Drosophila melanogaster* from gene *sc* to gene *f* to consist of two segments, the boundary lying between the genes *cv* and *c*[3]. This inference was confirmed cytologically, a constriction having been located almost at the same place[4].

The leading interval for both segments is *sc ec*, which conforms to the cytological observation[5]. Within one and the same segment, $\mathfrak{i}$ decreases inversely as $\mathfrak{M}$, yielding the constant of interference

$$\mathfrak{i}\mathfrak{M} = a\,,$$

unless $\mathfrak{M} < a$, for then this equation would give $\mathfrak{i} > 1$, an impossible frequency value. The assumption of the maximum possible value $\mathfrak{i} = 1$ for $\mathfrak{M} < a$ means that no double breaks exist, a being the distance of the absolute interference. The representation of $\mathfrak{i}\mathfrak{M}$ as a function of $\mathfrak{M}$ begins thus as a 45° straight line ($\mathfrak{i}\mathfrak{M} = \mathfrak{M}$) and continues with an angle at $\mathfrak{M} = a$ as a horizontal line. For the right segment the constant a amounts to $a_r = 0{\cdot}124$. In the experiment under discussion even the smallest $\mathfrak{M}$ of this segment is $> a_r$. On the left segment all $\mathfrak{M}$'s are evidently less than a_l; the $\mathfrak{i}\mathfrak{M}$ values lie nearly on the 45° straight line. For very small $\mathfrak{M}$ of this segment, they lie exactly on this line: in the region marked by the genes *sc*, *w*, *N*, *ec*, *rb*, not one double break was found among 160,000 flies[6]. In the "Xple" experiment the few double breaks actually occurring round off the angle at $\mathfrak{M} = a_l$, but the segment is too short to attain the value of the horizontal part $\mathfrak{i}\mathfrak{M} = a_l$. However, the existing part of the curve makes it possible to put $a_l = 0{\cdot}257$, the initial value of the transitive interference (Fig. 1).

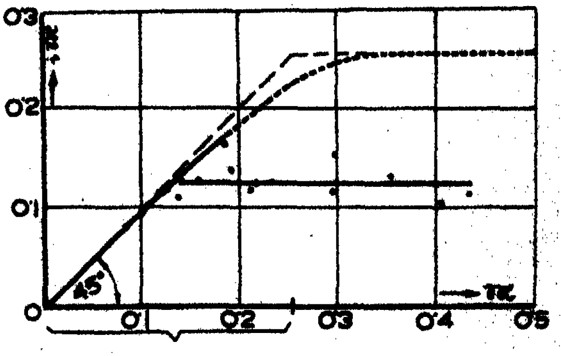

Fig. 1.

DOTS RIGHT SEGMENT, CIRCLES LEFT SEGMENT. ABSCISSÆ: PRIMARY MAP-DISTANCES BETWEEN THE MIDDLES OF THE INTERVALS, EACH PLOTTED FROM THE 0 POINT. INTERRUPTED LINES: SHORT DASHES, EXTRAPOLATED PARTS; LONG DASHES, LEFT SEGMENT ACCORDING TO THEORY.

The effect of a break in the left segment does not stop at the boundary, but induces interference in the right segment, which follows another law. This *transitive* interference begins at the boundary with an identical value of $\mathfrak{i}\mathfrak{M}$, in whichever interval of the left segment the first break occurred, and decreases along the right segment according to:

$$\mathfrak{i}\mathfrak{M} = a - b\mathfrak{M},$$

where $\mathfrak{M}$ is the whole map-distance between the two intervals, $\mathfrak{M}_r$ is the map-distance on the right segment from the boundary; $a = 0{\cdot}257 = a_e$, $b = 0{\cdot}559$ (Fig. 2). The limits of the validity of this equation can be discussed only when suitable experimental data are available.

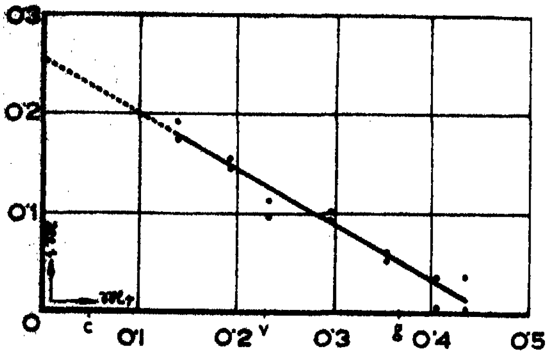

Fig. 2.

TRANSITIVE INTERFERENCE. ABSCISSA: PRIMARY MAP OF THE RIGHT SEGMENT; 0 POINT = MIDDLE OF THE INTERVAL CV C.

The three constants a_e, a_r, b make it possible to compute from six f-values between neighbour genes, which stand for the six observed f-values—that is, from the looi of the seven genes on the primary map—all 21 f-values, the average deviation being 0·6 per cent with a maximum of 1·8 per cent (Table 1).

TABLE 1. f-VALUES OF THE "XPLE" EXPERIMENT.

		sc	ec	cv	c	v	g
ec	Calc. Obs.	0·068 0·068					
cv	Calc. Obs.	0·164 0·163	0·096 0·096				
c	Calc. Obs.	0·247 0·245	0·179 0·180	0·083 0·084			
v	Calc. Obs.	0·371 0·370	0·314 0·314	0·227 0·228	0·147 0·147		
g	Calc. Obs.	0·428 0·430	0·385 0·387	0·317 0·319	0·251 0·279	0·112 0·110	
f	Calc. Obs.	0·466 0·465	0·436 0·435	0·389 0·389	0·337 0·334	0·221 0·219	0·112 0 114

The left segment was calculated on the basis of the simplifying assumption $i = 1$. Using Morgan's terminology, the two equations represent the relation between frequency of crossing-over and frequency of recombination[7].

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Raman Spectra of Deuteroethylenes

THE various deuteroethylenes can be obtained by exchange from ethylenes and deuterium oxide on a nickel catalyst. 15 gm. of heavy water (D_2O) and 6 litres of ethylenes (N.T.P.) yielded after an exchange of several days at 150° C. a mixture of ethylenes containing about 50 per cent of the hydrogen as deuterium. The Raman spectrum of this substance was taken. In order to identify the lines and attribute them unambiguously to the different compounds, some of the deuteroethylenes have been prepared in a pure state. The ethylene C_2D_4 was obtained in the following way:

$$C_2D_2 + 2DBr \rightarrow C_2D_4Br_2 ;$$
$$C_2D_4Br_2 + Zn = C_2D_4 + ZnBr_2 .$$

The compound so obtained contained about 10 per cent C_2D_3H; its D content was thus about 97 per cent of the total hydrogen. The *cis* and *trans* dideuteroethylenes were obtained in an analogous way starting from C_2D_2 and HBr. The comparison of the various spectra permits the classification of the lines as shown in the accompanying table:

C_2H_4	C_2D_4	$C_2H_3D_1$	C_2HD_3	$C_2H_2D_2$ *cis* and *trans*	$C_2H_2D_2$ asym.
1621	1515	1600	1545	1567	1581
3007	2251	3016	2272	2276	2221
1341	981	1397	996	2290	
3082	2304	3104		1282	1379
		1285		1214	
		2266	2215	3038	
		2965		3046	
				763	
				863	

(cm.$^{-1}$).

There is a slight discrepancy between the experimental results and the theoretical calculations carried out by Manneback and Verleisen. The potential function proposed by these authors has thus to be revised; this revision has been started by Manneback and his co-workers. The comparison of the first three lines (S_1 lines) of C_2H_4 and C_2D_4 gives a measure of the anharmonicity correction. The ratio of the product of these three frequencies should be 2. Deviations from this value are to be ascribed to the anharmonicity of the vibration. This constant was not taken into account in the earlier calculations; in fact, we find the value:

$$\frac{1621 \times 3007 \times 1341}{1515 \times 2251 \times 981} = 1{\cdot}954.$$

The results indicate that it is of the order of magnitude of 2 per cent. Several lines not given in the table could be detected in the spectrum of the dideuteroethylenes. It has not been possible to ascribe them unambiguously. Further work is in progress.

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Acidosis and Off-flavoured Milk

VETERINARIANS have assisted in explaining one cause of taint of milk when showing that in cases of acidosis the body fluids, including the milk, contain acetone and acetone-bodies. It was stated that the milk would react to Rothera's test[1].

As a result of recent experiences with samples of milk from cows suffering from acidosis, we can commend this very simple test to the dairy industry (it appears at present to be quite unknown) as a rapid and certain means of diagnosis, offering an explanation of many cases where the milk is mildly, but to a skilled palate, definitely of abnormal flavour even at the time of milking. Such cases have hitherto been somewhat vaguely ascribed to 'indigestion'. Furthermore, we find that for more accurate work, quantitative estimations may be made by the method of Van Slyke[2]. Several samples from cows giving tainted milk have been so examined, and in addition more than 98 per cent recovery has been obtained from samples of milk to which small amounts of acetone have been added.

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Aug. 3.

[1] Beaumont, G. E., and Dodds, E. C., "Recent Advances in Medicine" (1931), p. 70 (sixth edition).

[2] Van Slyke, D. D., *J. Biol. Chem.*, **32**, 3, 455 (1917).

Points from Foregoing Letters

COMPARISON of the change in the intensity of cosmic rays for a period of nine days (April 23–May 1, 1937) during a magnetic storm at Innsbruck (Austria), Cheltenham (Maryland, U.S.A.) and Huancayo (Peru), shows very good agreement in the general trend, according to Prof. V. F. Hess and A. Demmelmair. There is also a close parallelism to the change in the horizontal component of the earth's magnetic field during this period, and the authors conclude that cosmic ray ionization was influenced simultaneously all over the earth by the magnetic disturbances, and that the study of the magnetic storm effects will give valuable information on the distribution of energy in the spectrum of the cosmic radiation.

Chemical analysis of a sample of duckweed (*Lemna*) shows, according to Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunasheva, that the plant contains about one hundred times more mesothorium-I (10×10^{-14} per cent) than the water in which it grows (Orangery Pond, near Leningrad). On the other hand, although isotopes of thorium are present in water, they are not assimilated by the duckweed. The authors conclude that the plant assimilates radioactive elements in strict accordance with their chemical properties.

K. Hall and Dr. V. Korenchevsky find that the increase in the size of the adrenals in castrated rats is due to increase in the width of certain zones (fasciculata and reticularis) resulting chiefly from an increase in the size of the cells. They return to normal if sufficiently large doses of sex hormones (androsterone, testosterone, etc.) are administered. In a similar way, the large numbers of lipoid granules which invade the 'demarcation zone' upon castration may be made to disappear.

From the effect of critical concentrations of sodium azide or 2 : 4-dinitrophenol on the rate and extent of oxidation of acetate or butyrate by bacteria, Dr. C. E. Clifton deduces that these agents block the assimilatory process observed in association with the respiration of widely different non-proliferating cells under normal conditions. This blocking of the assimilatory process is accompanied by a complete oxidation of the substrate, at an approximately normal rate. He suggests that the weight-reducing action of the dinitrophenols in man may be due in part to a suppression of assimilatory processes.

By feeding rats with diets as used in Northern India, by well-to-do and by poor Hindus respectively, and observing the effects upon the teeth, the fertility and the health of the young, D. N. Mullick and Dr. J. T. Irving find that the Northern Indian diet is superior to both Hindu diets and that the poor Hindu diet is seriously defective as shown by both chemical and biological tests.

A table giving the amount of silica dissolved by a 1 per cent sodium bicarbonate solution and by acetic fluid from silica dusts (quartz, sericite) after various periods of time, is given by Dr. E. J. King. The author states that many of the values reported by Emmons and Wilcox for the solubility of finely powdered silicates are too high, because their method does not eliminate completely the fine particles in suspension.

The presence of a minute hole in a polished glass disk enables it to make 'optical' contact with another polished plate by application of slight pressure at a single point, according to Dr. J. W. French. The contact spreads spontaneously, due apparently to the surface tension effect of a grease-like film (less than one millionth of an inch thick) present at the glass surface.

D. Porret and Dr. E. Rabinowitch find that the reversible bleaching of chlorophyll by light is proportional to the square root of the light intensity. Formic acid causes a considerable increase in the reversible bleaching, while oxygen and ferrous chloride suppress it.

The interference in the two segments of the *X*-chromosome of *Drosophila melanogaster* is characterized by Prof. K. de Kőrösy by two constants, the *transitive* interference from one segment on the other by a third. The average deviation between the calculated and observed data is 0·6 per cent, with a maximum of 1·8 per cent.

A table showing the Raman spectra of various heavy-hydrogen substituted ethylenes is given by Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse. Some of the lines were determined by using pure compounds (C_2D_4, $C_2H_2D_2$) and the remainder from a mixed sample. The authors find a slight discrepancy between the experimental results and the theoretical calculations carried out by Manneback and Verleisen.

Research Items

Blood-Brotherhood in Dahomey

M. PAUL HAZOUMÉ, in the course of an account of the blood-pact in Dahomey (*Trav. et Mem. Inst. d'Ethnol., Paris*, **25**), has essayed a critical analysis of the practices and beliefs with which it is bound up. While religious practices and beliefs hold first place in the institutions of Dahomey, the blood-pact has a profound effect on the formation of character in the individual. It is this which has created their spirit of solidarity and at the same time is responsible for their reserve towards strangers. Those who are parties to such a pact are aware that although it does not create the deep-seated affections, which are attributed to the action of certain mysterious philtres, it does give rise to a feeling of unlimited confidence, because those who are bound by this tie are aware that their 'brothers' will never betray them with impunity. In other words, the chastisement which is the sanction of a violated oath will keep those who have subscribed to the pact within the paths of duty it has laid down. In the mutual drinking of blood they have taken on a mutual obligation of affection, confidence and help which overrides even the claims of blood relationship. The assistance due extends from the erection of huts and work in the fields to sacrifice of life itself. It involves the taking up of arms on behalf of blood-brothers against injustice and treachery. It is also a protection against robbery; and kings found in it an instrument of power for personal or political objects, disregarding rank and allying to themselves any who might prove useful to their purpose, including experts in magic and spies. On the other hand, no one was allowed to exploit this relation with the monarch for personal gain or social advancement. For long the pact had none but noble objects; but unfortunately it was perverted to evil ends and became an instrument of crime. Originally it was confined to adult males. Now it is a means of assuring the fidelity of married couples, and thieves have resorted to it to join to themselves women, who assist in their nefarious practices by entering into friendly relations with those whom it is intended to rob.

Pain Nerves

WHEN a sharp or a hot object is applied momentarily to the toe, two bursts of pain are felt, the second following the first by an interval of nearly two seconds. T. Lewis and E. E. Pochin (*Clin. Sci.*, **3**, 67; 1937) show that this double response depends on the transmission of pain-sense by two sets of nerve fibres having widely differing rates of conduction. They point out that if a pain stimulus is applied at different points on a limb, the interval between the two sensations lengthens as the periphery of the limb is reached. It has been shown by others in the experimental animal that asphyxia interrupts conduction in the fast before the slow fibres; cocaine, on the other hand, paralyses the slow fibres before the fast. Lewis and Pochin show that in man asphyxia abolishes the immediate but not the delayed response to pain, while cocaine abolishes the second response before the first.

Pharmacology of Tetramethylammonium

TETRAMETHYLAMMONIUM has various actions of pharmacological interest. A. J. Clark and J. Raventos (*Quart. J. Exp. Physiol.*, **26**, 361–392; 1937) have studied some of these actions and compared them with those of substances formed from it by altering some of the chemical groups in the molecule. The actions studied may be classified as muscarine actions (contraction of rat's intestine and inhibition of frog's heart), nicotine actions (contraction of leech muscle), atropine actions (inhibiting muscarine actions) and curare actions (inhibition of neuro-muscular conduction in voluntary muscle, which may be essentially an inhibition of nicotine actions). The action of drugs on the frog's rectus abdominis is apparently intermediate between these main types. Replacement of one methyl group by a straight-chain alkyl group of increasing length first increases the muscarine activity and then leads to the appearance of the opposed atropine activity. This is explained on a theory, to which Gaddum has given mathematical expression, according to which the antagonistic drugs combine with the same chemical groups in the tissues as the active drugs and block them up. The results generally agree quantitatively with this theory. These changes in the molecule do not much affect nicotine actions or curare actions. Replacement of all four methyls by ethyl, propyl or butyl abolishes muscarine actions and increases atropine actions. Replacement of methyl groups by increasing numbers of ethyl groups diminishes all actions except that on the leech, which is first diminished and then increased. The introduction of a phenyl group has an effect like that of the introduction of three carbon atoms in a straight chain.

Speed of Flight of Birds

IN a Circular (No. 428) published by the U.S. Department of Agriculture, May Thacher Cooke has collected all the records of the speed of flight of North American species of birds and of a few European species which have occurred in North America and are closely related to North American species for which no records are available. There are also included a few running speeds which show that for short distances quail may cover the ground at 12–15 miles per hour, the roadrunner at 10–20 miles, while for the emu Le Souëf's record is quoted of a bird driven for 10 miles at a speed of 31 m.p.h. Of the flight records it must be said that many are unsatisfactory, since it would appear that in many cases no allowance has been made for favouring or adverse wind. Thus presumably arises the anomaly of one observation from a moving train giving a speed of 25 m.p.h. for the crow, while another gives 60 m.p.h., and an automobile observation 25–32 m.p.h. But the author seems to consider that wind has no great influence upon the flight of birds, and in support she quotes the case of brown pelicans timed along the beach at El Pismo: 14 m.p.h. with practically no wind, 16 m.p.h. with half a gale blowing half rear, 22 m.p.h. with wind velocity of 60 m.p.h. in the same direction. The old statement is repeated that birds prefer a side or even a head wind to a following wind. Until observers realize that the speed of a bird's movement in relation to the ground has no biological meaning until corrections have been made for the influence of the wind, these faulty records will continue to accumulate.

Migrations of Salmon

FURTHER evidence of the actual movements of salmon in the sea is given by W. J. M. Menzies (Fisheries, Scotland, Salmon Fish., 1937, No. 1) from the recapture of marked fish. The main experiment was carried out in 1936 at Loch Inchard, twelve miles south of Cape Wrath, a spot chosen as the result of knowledge obtained from experiments in other localities in previous years. Of 1,255 fish marked, 11·7 per cent have been recaptured, at various places so far away as 145 miles to the south and 410 miles east, and south to the Yorkshire coast and even in Norway. The suggestion is put forward that these fish had collected at Loch Inchard from some feeding ground to the west or north, and thence migrated purposively to the positions at which they were recaptured. This view is supported in a remarkable manner by scale examination. As a result of extensive investigations in recent years, the type of parr growth, which differs from river to river, is now known for a large number of rivers. With one exception, all these recaptured salmon showed on their scales the parr growth typical of that of fish from the rivers in which they were recaught. This seems rather conclusive evidence that the fish were proceeding via Loch Inchard on a definite migration to their own particular rivers.

Hemipterous Insects of the Family Peloridiidæ

THIS small and scarce family of hemipterous insects was for a number of years only known from two examples from the southern extremity of South America. In 1920 a further example was discovered in New Zealand, and in 1924 a nymph was found on Lord Howe Island. Later, examples turned up in Australia and in 1933 a number of specimens were found in that country by Mr. I. W. Helmsing, which have enabled a more detailed study of the family to be made. In the *Annals and Magazine of Natural History* of May, 1937, Messrs. Helmsing and W. E. China discuss the Australian species, *Hemiodoecus veitchi*. The favourite habitat for this species appears to be among moss in forests of Antarctic beech (*Nothofagus moorei*). The few known examples of the family were formerly placed in the Heteroptera, but it is now agreed that its affinities are with the suborder Homoptera. These authors conclude that the establishment of a separate new suborder for the Peloridiidæ is not justified, and that the group belongs to a new series in the suborder Homoptera for which the name Coleorrhyncha was given by Myers and China in 1929. The Peloridiidæ are evidently a very primitive and generalized family associated with primitive vegetation (mosses), and it is concluded that its members may well have been descended in an almost direct line from protohemipterous ancestors.

Colour of Hydrangea Flowers

IT would perhaps be difficult to say whether pink or blue hydrangea blooms are most popular for floral decoration, but the reliable production of blue-coloured flowers has long been a horticultural desideratum. Mr. E. M. Chenery has made an exact study of this question, and his findings have recently been published (*J. Roy. Hort. Soc.*, 62, Pt. 7, 304–320, July 1937). The paper considers the problem from historical and horticultural points of view, and also compares the influence of soil conditions with the physiology of the plant. From all sources of evidence, aluminium seems to be the element the presence of which induces a blue colour in the flowers, and not iron, as was at one time supposed. Analyses of blue and pink sterile flowers or petaloid sepals showed that aluminium was always greatly in excess of iron when the blue colour appeared. The anthocyanin from pink flowers would, however, form a blue delphinidin complex with both iron and aluminium ions.

Dipterocarpaceæ of the Eastern Tropics

IN Forest Products Research Records No. 16 (Timber Series No. 5. H.M. Stationery Office, 1937), Mr. S. H. Clarke, under the title "Gurjun, Apitong, Keruing, Kapur and allied Timbers", deals with a group of timbers from the eastern tropics which has in recent years become increasingly important to the wood industries of Great Britain. From a commercial point of view, the family Dipterocarpaceæ is the most important group of timber trees in the eastern tropics—occupying a more or less similar position in Burma, the Malay Peninsula, Sumatra, Borneo and the Philippine Islands to that occupied by the soft woods in the great forests of Canada and the U.S.S.R.; the dipterocarps, however, rarely occur in pure forests, yet they yield a larger volume of timber than all the other species occurring in mixture with them. The family comprises nineteen genera and some 380 species. The *Shorea* timbers are the lightest; *Dipterocarpus* and *Dryobalanops* moderately heavy, and, though not very durable under exposed conditions in the tropics, are well suited for constructional and other purposes in the temperate climates. The hardest woods of the family come into the genera *Vatica*, *Hopea* and *Balanocarpus*. These are too heavy and hard to be of use for general purposes in Great Britain, though they form the chief constructional timbers in the countries producing them. The chief exploited species of the family are magnificent trees with a bole running up to 80 ft. or more without a branch, and a diameter which may reach 5 ft. Resin or gum occurs in some of the species. The pamphlet gives a general classification of the timbers in a tabular statement showing the countries of origin and the chief species of the principal genera *Dipterocarpus*, *Dryobalanops*, *Shorea*, *Hopea*, *Vatica* and *Balanocarpus*.

Erosion Surfaces of Cornwall

MARINE action has clearly played a great part in shaping the physiographical features of Cornwall. Platforms at 1,000, 800 and 400 ft. have been mentioned and a 200-ft. level has been suggested. Mr. W. G. V. Balchin, in an article in the *Geographical Journal* of July, gives the result of his investigations in north Cornwall, and tries to date the platforms which he has recognized, pointing out that the present physiography had its origin, for the major part, in the dissection of a series of platforms. The erosion surfaces are generally separated by a bluff which when not of structural origin is probably due to marine action. In the area investigated the highest platform, notable on Bodmin Moor, is at 1,000 ft. and is probably late Miocene. Below that is a minor platform at 850–920 ft., and again one at heights varying from 600 ft. to 820 ft. conspicuous near Camelford and probably later Miocene. The best preserved platform is at 300–430 ft., well seen between Boscastle and Tregardock and of Pliocene origin. Finally comes a surface at 240–285 ft. of late Pliocene age, noticeable in many of the flat-topped hills of the Padstow district.

Magmatic Differentiation

AT the Tercentenary Conference at Harvard University last September, Dr. C. N. Fenner summarized some of the major difficulties that are encountered in attempting to explain all the phenomena of differentiation of igneous magmas by a single process. The paper is now published in the *Journal of Geology* (158–168; 1937). It is pointed out that the Goose Creek diabase contains both quartzo-felspathic micropegmatite and very basic macropegmatite. Unless, therefore, liquid immiscibility be granted, both cannot represent residual magmas, since this would mean that the magma was differentiating simultaneously in two very different directions. The official interpretation of the Glen More ring-dyke (Mull) as an example of differentiation into gabbro and granophyre is shown to violate fundamental principles of chemistry and dynamics. Granitic rocks from the Bushveld Complex are similar to those which have been claimed as products of crystal fractionation from basic magma, and yet they have been demonstrably produced by the granitization of sedimentary quartzites. For many years, a controversy has been carried on as to whether, or to what extent, magmas are capable of assimilating solid rock. It has been repeatedly stated that the great obstacle to assimilation is the supposed inadequacy of the heat supply. Fenner describes phenomena from Alaska and the Yellowstone Park which irrefutably prove that "rhyolite magma was able to do things that the theory of crystal fractionation declares impossible". The facts show that rhyolite magma, so far from being the coolest of the evolution series, possesses great and hitherto unsuspected reserves of latent energy. Fenner insists on the necessity for giving such facts more adequate consideration. So did Goodchild more than thirty years ago, in a paper that was quietly ignored (*Trans. Roy. Soc. Edin.*, 202; 1904), so strong was the prejudice in favour of theory when theory and observation were in conflict. Fortunately, that prejudice is at last crumbling away, as the irrepressible facts become more widely known.

Retardation of Chemical Reactions

THE reaction between potassium permanganate and hydrogen peroxide is retarded by hydrogen peroxide in fairly concentrated solution, an effect which has been attributed to the formation of inactive H_4O_4 molecules at higher concentrations. K. C. Bailey and G. T. Taylor (*J. Chem. Soc.*, 994; 1937) have re-investigated the reaction, measuring the extent of decomposition with a photo-electric colorimeter, the effects of stirring and of traces of manganous ions being particularly controlled. With initial permanganate and sulphuric acid concentrations constant, the reaction velocity reaches a maximum at $(H_2O_2) = 0{\cdot}005$ equiv./l., falls to a minimum at $(H_2O_2) = 0{\cdot}16$, and rises slowly at higher peroxide concentrations. With initial permanganate and peroxide constant, and the latter at concentration greater than 0·02, the velocity rises to a maximum with increase of sulphuric acid, falls to a minimum, and then rises again. Manganous ions catalyse the reaction powerfully at peroxide concentrations rising to the maximum velocity concentration but have little effect near the minimum velocity. Other effects were found and a theory covering all the data is not proposed. It is considered that the reduction of MnO_4' to Mn'' probably takes place in stages, the first perhaps involving the production of MnO_3' which may be capable of being re-oxidized to MnO_4' by a molecule of H_2O_2 with sufficient energy. A fair agreement with experiment is obtained by an empirical equation : $v = k_1(H_2O_2)(H_2SO_4)(KMnO_4)\ /\ (k_2+k_3(H_2O_2)^2(H_2SO_4)^2)$, the terms in the denominator representing two types of retardation, the second being the re-oxidation of partly reduced permanganate by active hydrogen peroxide.

Investigation of Porous Structure

AN emanation method has recently been described (G. Graue and N. Riehl, *Naturwiss.*, 25, 423; 1937) which offers possibilities of examining the porous nature of catalysts and of studying reactions in solid phases. The emanation method of Hahn, first described in 1929, depends on introducing a radioactive element which forms a gaseous emanation on disintegration into the solid. The degree of porosity is indicated by the quantity of emanation which can be detected in the neighbourhood of the solid. This method has the disadvantage that it can only be used for special substances in which the radioactive substance can be included. The method now proposed is to allow the emanation to penetrate the solid from outside, the amount penetrating indicating the porosity. The method has been used to determine the true specific volume of crystalline and precipitated zinc sulphide. The value obtained for the specific volume of crystalline zinc sulphide was the same as that determined by the pyknometer method, but for precipitated zinc sulphide the value obtained by the emanation method was much smaller than that with the pyknometer. It must therefore be assumed that in amorphous (precipitated) zinc sulphide there are pores or fissures of atomic dimensions due to an irregular arrangement of atoms. It is possible that gases penetrate into the interior of solid catalysts not only by means of large pores, but also by inter-atomic pores and clefts due to badly formed lattices.

Recent Sunspot Activity

DATA contained in Nos. 36 and 37 of the Zurich *Bulletin for Character Figures of Solar Phenomena* for the six months October 1936–March 1937 show how considerable has been the sun's activity of late. The mean daily sunspot 'numbers' for each of the six months are, respectively, 89, 115, 123, 133, 128 and 84. The highest value reached in the preceding 11-year cycle was 108 for December 1929; but in the earlier cycle with a maximum in 1917 the value 155 was reached in August of that year. The mean number for the year 1936 was 80·4 as compared with 36·1 for 1935, 8·7 for 1934 and 5·7 for 1933. Since March 1937, activity has remained considerable. Large sunspots crossed the sun's central meridian on April 22·4, April 23·2*, April 24·6*, April 29·6, May 20·8*, May 27·2, June 4·9, June 15·6, June 16·9*, June 21·2, June 27·0 and July 28·6*. Those groups marked with an asterisk exceeded, at maximum development, 1,000 millionths of the sun's hemisphere as given by the Greenwich measures of area.

The Palace of Discovery at the Paris International Exhibition, 1937

By Dr. Pierre Biquard

EVERY day thousands of visitors from all parts of the world enter the Palace of Discovery of the Paris International Exhibition. Some go as experts to see how far science lends itself to spectacular demonstration. Others, realizing their lack of knowledge, go to learn. Furthermore, some people, especially the young, go brimful of eager curiosity, hoping to find somewhere in those halls an inspiration which will guide them in the choice of their career.

One thing is certain, no one is disappointed. It is obviously impossible to cover in a brief article the entire field of present-day science, and relate the history of scientific progress up to date. This is merely a brief statement of what has been achieved in the different sections of the Palace of Discovery. The Palace covers an area of 23,000 square metres. All branches of scientific learning are represented, from mathematics and astronomy to medicine and botany.

The greatest efforts have been made to replace by real demonstrations the silent testimony of documents and pictures. In all sections a staff of demonstrators escort the visitors and carry out experiments, though many work automatically and can be set in motion by the public. The magnitude of the undertaking is shown by the single fact that the electrical installation of the Great Palace is on a greater scale than that of a whole district in Paris: ten kilometres of feeders and sixty kilometres of cables were needed, and it is estimated that the cost of the electricity used during the course of the Exhibition will amount to 1,000,000 francs.

In accordance with the views of Auguste Comte, mathematics will be dealt with first. It may be true, as Emile Borel wrote in Paris, 1937, that "only those who have given up their lives to mathematical research know what it is, what are its aims and by what means it attains them"; nevertheless the rooms set apart for mathematics show to all visitors the development of this science from the earliest times and the growing importance that it has acquired in modern developments of physics, chemistry, biology, etc. Certain questions are explained by means of films: in this way visitors are introduced to such subjects as four dimensional space and the laws of similitude, showing that if the dimensions of an individual were increased ten times he would collapse under his own weight. Mathematicians are given the opportunity of working out on the spot at the blackboard problems the solutions to which are posted up the following day. It is interesting to see that the eternal riddle of the squaring of the circle occupies a place, and the value of π to 707 places of decimals is exhibited on the surface of a cupola.

The task undertaken by those responsible for the astronomy section has been no small one. They have had to crowd into a few rooms all that is known about a universe so vast that light takes a thousand million years to traverse it. Three models show the structure of portions of space of decreasing sizes: the first represents the galaxy, the diameter of which is of the order of five million light years: the second shows the sun and the twenty-five stars surrounding it in a portion of space through which light travels in twenty-five years: finally, the third model shows the sun and its attendant planets, that is, a very small space through which light travels in seventeen hours. The northern Milky Way is shown in a photographic enlargement measuring 20 m. × 4·5 m.; there are also many good photographs of nebulæ, of the sun, moon, planets, comets, etc. The movements of the planets in the solar system are reproduced in the great planetarium, and to make them more clearly visible, the rates of their revolutions have been multiplied by 432,000, allowing one revolution of Mercury around the sun to be seen in eighteen seconds. After having examined all that can be seen in space from the earth, the visitor naturally wonders what our world would look like to other beings living on some other planet. An answer to this question is given by a model 70 cm. in diameter which was made as the result of the observations of explorers of the stratosphere.

Physics occupies a favoured position in the Palace of Discovery. In a room dedicated to Galileo are seen the fundamental experiments relating to falling bodies, the oscillations of the pendulum, centrifugal force, the laws of composition of forces. All the foundations of the so-called 'rational' mechanics are there, and it is impossible not to dwell on the scientific progress in physics and astronomy made on this basis up to the time when its application to optics was found to be impossible.

The history of our knowledge concerning light appears in the section devoted to optics. After having thus learnt anew the laws of reflection and refraction, and measured the velocity of the propagation of light, the visitor can watch a series of experiments on interference, diffraction, polarization, interference photography, and will then perhaps be convinced of the truth of the wave theory of light. The photo-electric phenomena which can be examined later will give him food for thought.

Another section is given over to electrostatics. Once again the public may see the production of electric charges by the friction of cat skin and, on the other hand, watch the working of the Van de Graaf electrostatic machine set up under the direction of M. Joliot by MM. Lazard and Savel. This machine can produce sparks of several million volts passing between two spheres of three metres diameter.

The field of oscillations is the subject of another section in which electromagnetic and sound vibrations are studied. Special attention must be directed to the manner in which are exhibited the consequences of the discovery by Pierre and Jacques Curie of the piezo-electric property of quartz; the stabilization of high-frequency emissions, quartz pianos, emission and reception of ultra-sound waves, submarine sounding, etc.

Ampère's experiments and the laws of electrodynamics lead up to the triumphs of electrotechnics. By a parallel procedure, it is possible to follow the progress which, starting with the phenomenon of thermionic emission, has led to the creation of modern radiotechnics.

Some of the most beautiful experiments are shown in a section devoted to the states of matter and the structure of the atom. Matter is heated, cooled, compressed under several thousand atmospheres, expanded, etc. The experiments shown on fluorescence and phosphorescence are as conclusive as they are beautiful. Last comes what is perhaps the most glorious chapter of modern science, the study of atomic particles and radiations. In this section are reproduced all the experiments which have marked a decisive step forward in the study of electrons, of X-rays and the radiation of radioactive bodies, thus passing from the first Crookes tube to the artificial radio-elements and to the cosmic rays made visible thanks to the Wilson expansion chamber.

Four laboratories have been chosen by the chemists to show the history of their particular branch of science: an alchemist's laboratory, Lavoisier's laboratory, Berthelot's laboratory and finally a modern chemical laboratory. While further on, the 'elements' air, water and fire have a special room reserved for them. A great illuminated chart shows the periodic classification of the elements and an ingenious arrangement demonstrates the structure of all the atoms, from hydrogen to uranium. The principal analyses and syntheses are reproduced before the visitors' eyes, notably the separation of the gases of the air and the synthesis of acetylene in Berthelot's 'electric egg'. With regard to each of the important branches of this science—physical chemistry, inorganic chemistry, organic chemistry, metallurgical chemistry, photochemistry, geochemistry—it is possible to estimate how much the researches of pure science have contributed to the progress of industry (paper making, manufacture of sulphuric acid, preparation of colouring matters, dyeing and printing of materials, etc.).

Biology, as might be expected, shows here a living summary of the work of Pasteur together with an exhibit of the developments of microbiology—discoveries relating to smallpox, intestinal affections, cholera and typhus.

Medicine is divided into: (1) the diseases of nutrition, (2) cardio-vascular pathology, (3) medical physics, and (4) the history of medicine, in which special stress is laid on the fundamental part played by the discovery of auscultation. Also, for surgery, the considerable progress made in the last ten or twenty years is shown, more especially the influence of discoveries bearing on asepsis and anæsthesia. If anyone wishes to learn more about his own organism, and to know what his qualities are, both good and bad, he may take his place on the seat where the human machine is tested. There, after a series of tests, his biometric ticket will be made out and may prove useful in choosing a profession. If the results are good, he will be all the more surprised when confronted with the sensorial illusions shown in the section of psycho-physiology. Experimental biology demonstrates how living beings react to physical and chemical reagents. Plant physiology and biology are illustrated by dioramas, films and collections. Finally, mention must be made of the section reserved for plant genetics, in which are exhibited the great facts of natural selection, of the formation of new species and of natural or induced changes.

Space will not permit the inclusion of the names of the many scientific men from France and abroad who have collaborated in the preparation of this great Exhibition. One exception must, however, be made in the case of the president, M. Jean Perrin. This Palace is the fruit of his untiring labours, and it is thanks to him also that France will soon possess a permanent Palace of Discovery.

It is only natural that in an exhibition representing the arts and technical sciences in modern life, scientific discovery should have its rightful place as the foundation of all progress. The Palace of Discovery brings this home to the general public and also shows the real beauty of science. Possibly, on leaving, the visitor will realize the truth of these words taken from Henri Poincaré's "Dernières Pensées": "Celui qui aura goûté à la Science, qui aura vu, ne fût-ce que de loin la splendide harmonie des lois naturelles, sera mieux disposé qu'un autre à faire peu de cas de ses petits intérêts égoïstes ; il aura un idéal qu'il aimera mieux que lui-même et c'est là le seul terrain sur lequel on puisse bâtir une morale".

A Mesolithic Site in Brittany*

THE Mesolithic site of Téviec, a rocky islet situated about eighteen hundred metres west of the shores of the peninsula of Quiberon in Brittany, which has been explored by M. and Mme. Péquart, is up to the present the most important station of this period that has been submitted to systematic and complete examination. Incidentally, it may be said, it gains in significance by the fact that examination of human skeletal remains from Téviec has elicited from MM. Boule and Vallois a detailed analysis of the physical characters of Mesolithic man, so far as known from the remains which have survived, and a comparison of this race or type with those of the Upper Palæolithic.

The investigations leading to the discovery of the site were undertaken by M. and Mme. Péquart in the hope of throwing light on the domestic and tribal economy of the early inhabitants of Brittany, which had been neglected by archæologists owing to their preoccupation with the all-absorbing study of the monuments of the country. For this purpose they were convinced that there was little hope of obtaining undisturbed evidence on the mainland, and consequently directed their investigations to the numerous small islands which lie off the coast of the Morbihan. In 1926 they were attracted by the evidence of a kitchen-midden exposed by marine erosion on this barren rock—it is little more, its dimensions being only four hundred metres in its greatest length and two hundred metres at its greatest breadth, while its elevation over the greater part of its extent is no more than ten metres—and began its excavation in July, 1928. After twenty-one days' excavation they were rewarded by the discovery of the first burial. The work of excavation was continued in 1929 and 1930.

The island is completely barren, and even with the resources of modern civilization the excavating party found difficulty in keeping themselves provisioned during their stay on the island. There is, however, reason to believe that at the period of occupation under investigation the island was joined to the mainland, and the mode of life of the inhabitants was riverine, rather than marine. This view is supported by the character of the charcoal, of which an abundance was found. This is the produce of forest trees. The animal remains are also those of a forest fauna. The inhabitants, however, do not appear to have subsisted to any great extent by either fishing or hunting, and their diet was almost exclusively of shell-fish. There is no supply of fresh water on the island.

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* Téviec : station-nécropole mésolithique du Morbihan. Par Marthe et Saint-Just Péquart, M. Boule et H. Vallois. (Archives de l'Institut de paléontologie humaine, Mémoire 18.) Pp. ii+227+19 plates. (Paris : Masson et Cie., 1937.) 220 francs.

It was largely this difficulty of making any prolonged stay on the island that was responsible for the fact that it had not been explored archæologically. The site was actually first discovered by M. F. Gaillard in 1883, but he was able to do no more than make a few *sondages* on the north-west of the island. This brought to light some fragmentary evidence of a cooking-place and gave an approximation of the extent of the kitchen-midden; but the great antiquity of the site was not appreciated. The present explorers recognized by the quantity of culinary refuse, molluscs, fish and game, the quantity of charcoal and the fragments of bone and stone, as well as of the finished implements of these materials, that they were dealing with a kitchen-midden, while the absence of pottery and polished stone as well as the Tardenoisian character of the industry, indicated a Mesolithic site, or to be more precise a site belonging to a phase of culture corresponding to the post-Azilian Maglemose, Mullerup, or Mugem.

The station covers a superficial area of about two hundred metres square, though without doubt originally it was much larger. Much of it has disappeared by marine erosion. The archæological bed runs to a depth of from 0·60 m. to 1 m. and is entirely homogeneous throughout its depth in composition and contents. It is composed of a black earth, heavily loaded with carbon, indurated, but breaking up readily, owing to the mass of organic material, bones and artefacts, it contains. The artefacts are homogeneous in character throughout. The site was, in the words of the authors, "vierge de tout remaniement".

A number of hearths and burials were found, constituting in all "18 monuments". The burials were of twenty-three individuals, male and female, adult, adolescent and infant. In several instances infants were found buried with adults, for reasons that are not apparent. It is not invariably the burial of mother and child. In one grave the adult was male. Provision was made for the after-life in the form of implements and ornaments, especially necklaces of shells, placed with the body. There appears to be a ceremonial use of deerhorn, possibly as a mark of a special position in the tribe, which recalls the magical significance of horns in Palæolithic art, as well as possibly being an anticipation of later belief.

The hearths which were found appear to fall into different categories. They are classified by the authors as domestic hearths, which show heavy and protracted use in the calcining of the stones used, cooking hearths, possibly set up for funerary feasts, and ritual hearths for sacrificial meals, which do not show the same signs of protracted use.

The burials are partly in the soil and partly covered by the kitchen-midden material. They show no signs of orientation. The bodies are disposed in a sitting position, with the legs forcibly flexed and the back against the wall, or else laid on the back, with head and shoulders raised, and the legs flexed, or sometimes crossed on the stomach.

The station is not in reality rich in industries of either bone or stone. Stone artefacts fall into three categories—small implements of geometric outline, finely and carefully worked, flakes retouched over part or the whole of their outline, and a group of specimens of larger size, bolder flaking, comprise nuclei, scrapers and thick flaked tools of various types, in which the fracture seems crude, rather than purposively directed. The bone objects include handles of deerhorn, polishers, objects of indeterminate use made from the tusk of a boar which may have been for piercing leather, and various points, of which one form, a "stiletto" (though only 15–17 cm. long) appears to be accorded a special position in certain burials. Several objects show a simple attempt at decorative art in the form of engraved parallel diagonal or vertical lines. There is no evidence whatever of anything in the nature of permanent structures for habitation.

This discovery of a Mesolithic habitation-necropolis has for prehistoric studies, and for the study of the Mesolithic in particular, a triple interest. It shows for the first time in the prehistory of Brittany a homogeneous and sealed station in the Morbihan of civilization of a people anterior to the builders of the megaliths, and proves, what had previously been denied, that Brittany was inhabited before the Neolithic age. In regard to French prehistory, Téviec may be regarded as the type station of the French Mesolithic, and in fact it is the first to furnish in abundance for France evidence relating to the fauna, flora and industries of that period, while it is the only station which has yielded such an abundance of material for the study of the physical characters of the peoples of Mesolithic age. Further, it throws a flood of light on their culture and beliefs. Finally, in relation to prehistory in general, it makes an important addition to knowledge of the distribution in Europe of Mesolithic culture and a link between the stations of the north of Europe and the south.

While it is clear that this Mesolithic civilization has no relation with the Neolithic of Brittany, there is no indication of its origin. Like the Mesolithic elsewhere, it shows certain features reminiscent of Palæolithic culture, and it may be that it is a descendant of a Palæolithic of Brittany as yet unknown.

The physical characters of the inhabitants of the site may be summarized as follows, although this affords only a very inadequate idea of the carefully detailed examination of the skeletal material which has been made by MM. Boule and Vallois.

From the twenty-three burials, twenty-one skeletons were obtained in such a state of preservation as to afford material for observation and study. In general terms, the subjects were not of an advanced age, and there was none who could be described as elderly. Of two very young individuals a few teeth only were obtained. Of the remaining twenty-one, six were infants and six only were truly adult, five ranging in age between twenty and twenty-five years. The sex was easily determined, as in all but one instance the difference between male and female was stongly marked. Out of fourteen individuals six were male and eight were female. An indeterminate individual was probably male, though a low stature possibly indicates a female.

The head measurements were: length, male, 180–190 mm., female, 170–190·2 mm.; breadth, male, 129–143 mm., female, 133–142 mm.; basi-bregmatic height, male, 128–150 mm., female, 129–142 mm.; capacity, male, 1,561 c.c., female, 1,548 c.c.; cephalic index, male, mean, 74·3, female, 75·1. The skulls show a tendency to vary from a moderate dolichocephaly to mesocephaly, this tendency being more pronounced in the female.

In general character the skull is massive, but without marked prominences, thick, and relatively capacious. In form it is 'beloid'. It is high, especially in the men, and carinated with a pronounced median ridge. The forehead is broad and rounded, the glabella moderately developed. The face is large and low, euryprosopic, and mesognathous to prognathous. The mandibles are robust with a pronounced chin. The dentition is megadont. The teeth are remarkable as showing the first known example of caries, not previously recorded before Neolithic times. The stature is distinctly below medium. The forearm is relatively long. The lower limbs show marked platymeria, and the tibiæ are platycnemic. As a type, this population is well evolved.

MM. Boule and Vallois have also, as a basis of comparison, made a detailed survey of all the skeletal material of man surviving from the Mesolithic period. This they classify into five types—the Ofnet brachycephal, the dolichocephalic-mesocephals of Téviec, the Ofnet dolichocephals, the Mugem dolichocephals, and the Natufians of Palestine.

On the whole, the authors are inclined to the view that notwithstanding certain clearly marked differences there is a close resemblance between Téviec man and the Chancelade skull of the Upper Palæolithic. It is certainly closer than to Cro-Magnon man. Of the three possibilities that the type is new in western Europe, that it is a cross-breed, or that it is a variation from Chancelade which has been produced in the long interval of time which has elapsed between the occurrence of the two types, the authors incline to the last-named.

The Electrotor Smoke and Dust Meter

A RECENT paper by Dr. S. C. Blacktin (*J. Indus. Hygiene and Toxicol.*) describes an instrument he has devised for measuring dust suspended in the air. It is of a new type, and in designing it he has attempted to "avoid extraneous mechanisms or electric batteries which mar convenience and portability". The instrument consists of a hand pump of 100 c.c. capacity which draws air through a number of small nozzles, causing it to impinge upon a disk of celluloid or ebonite which, during the impact of the air, is made to revolve by means of a coarsely screwed rod which engages a nut or suitable projection in a hollow piston rod. The revolution of the disk is said to electrify it by rubbing against insulating material. In operation, a clean disk is inserted in the cap and the pump handle is next withdrawn to its greatest extent, and the cap with its disk screwed into position. The pump handle is next pressed inwards, rotating and electrifying the disk and emptying the pump. The ingress port is now held in the dust or smoke dispersion to be determined and the pump handle is withdrawn to its greatest extent with a steady pull. The air or gas entering the ingress holes against the electrified disk is said to deposit its particle content. The records obtained appear to be circular rings upon the record disk, and these are examined in the usual way under a suitable microscope.

In the paper the instrument is illustrated and described, but no data are given on its efficiency of operation. The apparatus is very simple and, provided it fulfils the function it is intended for, should be a useful addition to the methods available.

It is not easy to see how the construction described could be very effective in its operation; for example, it appears that the dust deposit takes place upon the surface of the disk which is being rubbed by rotation and electrified. Mechanically speaking, it cannot be easy to ensure a suitable rubbing pressure between the disk and the surface in contact with it, taking into account the clearances required in the bearings of the screw and such like. However, as stated already, no information is given on its actual use.

J. S. OWENS.

Performance of Noise Meters in Terms of the Primary Standard

DURING the past few years considerable progress has been made on the intricate subject of noise measurement and many experimental data are now available. A paper on this subject was read by B. G. Churcher and A. J. King to the Institution of Electrical Engineers early this year.

Since loudness is a sensation and not a physical magnitude, its definition and measurement involve subjective considerations such as the manner in which the sound is heard. Until recently these factors were not specified, and so the various types of portable noise meters in use gave appreciably different indications for a given noise. The British Standard Institution (B.S.I.) has taken an important step in removing difficulties. It has published an authoritative glossary of acoustical terms and definitions (B.S.S. 661) to which most of the workers in Great Britain will conform. Loudness is defined as, "that subjective quality of a sound which, in general, increases regularly with the intensity within the limits of audibility". A natural loudness scale is one such that when the number of units on the scale is doubled the magnitude of the sensation experienced by normal listeners is doubled also. The expression "equivalent loudness" has been adopted for the physical intensity level of the reference tone relative to the standard pure tone. The unit of equivalent loudness is the 'phon', which is defined as follows: "The standard tone shall be a plane sinusoidal sound wave train coming from a position directly in front of the observer and having a frequency of 1,000 cycles per sec". It is also stated that the listening must be done by both ears, the standard tone and sound under measurement being heard alternately. If when measured in this way the intensity level is found to be *n* decibels above the standard tone, the sound is said to have an equivalent loudness of *n* phons.

Equivalent loudness is defined in terms of the loudness-equality judgment of a hypothetical "normal observer" whose loudness judgment is representative of the average person. A group of persons is therefore selected; the larger and the more representative the group the more closely in all probability the group judgment will approximate to that of the normal observer. Experience shows that good results can be obtained, using mathematical statistical methods, with ten normal observers.

Reproducible noises of physically specified composition are set up by means of a loud-speaker, and their phon values determined in accordance with the definition. The same noises can then be applied to noise meters of any type and the difference between the phon values is the meter error for the type and level of the noise applied.

The measurement of noise is a problem of great and increasing importance in engineering. The authors conclude that the B.S. phon enables a consistent and unifying system of noise measurement to be set up, relevant to the manner in which sounds are normally heard.

The measurement of the frequency, intensity, purity and field distribution of the experimental tones is effected by condenser microphone methods. The analyser has a range of 25–25,000 cycles per second, is continuously adjustable and is highly sensitive. The microphones are calibrated by means of a Rayleigh disk. An ingenious electromagnetic tone generator is described by means of which harmonic noises containing up to ten components of any relative intensity may be set up.

Academy of Sciences, Vienna

ANNUAL MEETING

AT the general meeting of the Academy of Sciences in Vienna, held on June 1, the following officers were elected: *President:* Dr. Oswald Redlich, emeritus professor of history in the University of Vienna; *General Secretary:* Dr. Egon von Schweidler, professor of physics in the University of Vienna; *Secretary of the Philosophical and Historical Section:* Dr. Heinrich Ritter von Srbik, professor of history in the University of Vienna.

The following were elected to membership of the Philosophical and Historical Section: *Active Members:* Dr. Camillo Praschniker, professor of classical archæology, Dr. Rudolf Egger, professor of Roman antiquities, and Dr. Johannes Mewaldt, professor of classical philology, all of the University of Vienna; *Corresponding Home Members:* Dr. Friedrich Wild, professor of English philology in the University of Vienna, Dr. Franz Martin, director of land administration records in Salzburg, Dr. Alfred von Verdross, professor of international law in the University of Vienna; *Honorary Foreign Member:* Dr. Edward Schröder, emeritus professor of German language and literature in the University of Göttingen; *Corresponding Foreign Members:* Dr. Walter Otto, professor of ancient history in the University of Munich, Dr. Jan Huizinga, professor of history in the University of Leyden, Dr. Friedrich Panzer, professor of German language and literature in the University of Heidelberg, Dr. Theodor Litt, professor of philosophy and pedagogy in the University of Leipzig, Dr. Adolf Grohmann, professor of semitic philology and cultural history of the Orient in the German University of Prague.

The following were elected to membership of the Mathematical and Scientific Section: *Active Members:* Dr. Karl Terzaghi, professor of hydraulic engineering in the Technische Hochschul in Vienna, Dr. Theodor Pinter, emeritus professor of zoology in the University of Vienna, Dr. Erwin Kruppa, professor of descriptive geometry in the Technische Hochschul in Vienna, Dr. Leopold Adametz, emeritus professor of animal genetics in the Technische Hochschul of Agriculture in Vienna, Dr. Richard Schumann, professor of geodesy and astronomy in the Technische Hochschul in Vienna; *Corresponding Home Members:* Dr. Josef Weninger, professor of anthropology, Dr. Johann Sölch, professor of geography, Dr. Roland Grassberger, professor of hygiene, Dr. Karl Mayrhofer, professor of mathematics, all of the University of Vienna, and Dr. Wilhelm Petrascheck, professor of geology, palæontology and stratigraphy in the Montani Hochschul in Leoben; *Corresponding Foreign Members:* Dr. Otto Grosser, professor of anatomy in the German University of Prague, Dr. Enrico Fermi, professor of physics in the University of Rome, Dr. Ernst Küster, professor of botany in the University of Giessen, Dr. Hermann Nilsson-Ehle, professor of botany in the University of Lund and director of the Plant Breeding Institute in Svalöf.

The following awards were made by the Academy: the Ignaz L. Lieben prize, which this year is awarded for physics, to be divided equally between Dr. Marietta Blau and Dr. Hertha Wambacher for their work on the photographic action of α-rays, protons and neutrons; the Rudolf Wegscheider prize for chemistry to Dr. Otto Brunner for his work on stearins and the vitamins of the eye; the Fritz Pregl prize to Oberst Max Haitinger for his work on fluorescence microscopy.

Science News a Century Ago

Dr. Andrew Fyfe on the Voltaic Battery

THE first article in the *London and Edinburgh Philosophical Magazine* of August 1837 was by Dr. Andrew Fyfe and was entitled "On the Use of Sulphate of Copper for exciting Voltaic Electricity and on the Employment of Iron in the Construction of Batteries". Fyfe was aware that sulphate of copper was easily decomposed by zinc, and was induced to try it as the exciting fluid in the galvanic battery; he found it far superior to the acids in common use. He had a trough constructed of copper and sheet-iron, the plates being of the same size and number as those in a zinc battery. When sulphate of copper was used in the batteries, "electrolyzation", he said, "commenced almost the instant the trough was filled, and continued in the same way as when zinc was employed, indeed I could observe little difference as to energy of action and to the time that it continued, with this exception, that in general there was rather less gas evolved in the volta-electro meter". In view of the cheapness of the materials used, he conceived that the iron trough might be used for certain purposes.

Fyfe, who was born on January 18, 1792, and died on December 31, 1861, graduated in medicine in 1814 at Edinburgh. At one time he was assistant to Thomas Charles Hope (1766–1844), the professor of chemistry, and himself lectured privately on that subject. In 1827 he published his "Elements of Chemistry". He was president of the College of Surgeons, Edinburgh, in 1842–43 and in 1844 was appointed to the chair of chemistry at Aberdeen, a post he held until his death.

Science in Parliament

COMMENTING on the approaching opening of the first parliament of the reign of Queen Victoria, the *Mechanics' Magazine* of August 1837 said, "The new parliament will, to all appearance, have a smaller number of scientific members (always few enough) than the last, which, in its turn, had fewer than that which preceded it. Sir George Cayley will have no seat in the first parliament of Queen Victoria, while Mr. Babbage is further off the object of his ambition than ever . . . The principal scientific men who remain there are Mr. Heathcoat, the member for Tiverton, well known for his inventions in lace machinery, and the (said-to-be-unsuccessful) steam plough; Mr. Handley, the member for Lincolnshire, whose exertions to introduce steam-machinery in agriculture have been great and long continued; and Mr. Jephson, the member for Marlow, who holds a high reputation in the mechanical world. We believe Mr. Rotch, the barrister, better known to fame as the inventor of the patent screw-fix, has not secured a seat on the present occasion, or, of course, he would have been added to the scanty list."

The First French Railway

IN August 1837, the railway between Paris and St. Germain—the first in France—was opened. Writing on August 26, the correspondent of *The Times* said, "Paris has put on her seven-leagued boots, and reached St. Germain in a stride! The chateau of Louis le Grand, and the fine terrace sweeping through the forest until it is lost in distance, have kindly consented to approach the metropolis for the gratification of the numerous *quidnuncs* who inhabit it; and St. Germain, with all its interesting scenery, although, if we are to credit the map, it is twelve good English miles from Paris, is now more accessible than the windmills of Montmartre. This *triomphe merveilleuse*, as the Parisians delight to call it, is the work of that grand miracle-monger of the nineteenth century—steam . . . For statistics, it will be sufficient to state that the *matériel* is composed of 105 vehicles, capable of containing 4,070 persons, and of transporting the entire population of Paris to St. Germain in the course of one fine Sunday. The railway, 4½ leagues in length, passes through a beautiful country, traversing no fewer than eighteen bridges, three of which are across the Seine. . . . There is a tunnel, Batignolles, which is divided into two galleries, being above 400 metres. The construction is very solid, the rails being fifteen times heavier than those upon the Liverpool and Manchester road." An account of the lines was published shortly afterwards in the *Mechanics' Magazine*, in which it was stated the rails were 60 lb. per yard as compared with the 30 lb. per yard of those on the Liverpool and Manchester line. By 1840 there were 265 miles of railways open in France; by 1860 this had increased to 5,863 miles and by 1882 to 17,006 miles.

Societies and Academies

Dublin

Royal Dublin Society, May 25.

Report of the Radium Committee for the year 1936. The total number of millicuries of radon issued during the year was 12,635, the number of cases recorded in the report being 552. The report includes a number of detailed reports by various users of radon supplied by the Society.

M. J. GORMAN: A non-bulbing derivative of yellow-fleshed Swedish turnip. A non-bulbing form described resembles Swedish turnip (*Brassica napus* var. *napobrassica*) in having yellow flesh, buff flowers, and behaving as a biennial. By selfing, successive generations were obtained of rape-like plants quite uniform in appearance and similar to the original.

J. BREEN, J. KEANE and **T. J. NOLAN**: The chemical constituents of lichens found in Ireland—*Pertusaria concreta*. The main constituent of this lichen is *nor*-stictic acid $C_{18}H_{12}O_9$. Besides mannitol, it also contains a small amount of a substance crystallizing in yellow needles, m.p. 287° C. This latter substance, $C_{14}H_7O_5Cl_3$, contains three hydroxyl groups and is probably a trichlor trihydroxy methyl xanthone. It gives an olive green coloration with ferric chloride.

Paris

Academy of Sciences, June 21 (*C.R.* 204, 1849–1908).

LÉON GUILLET and **MARCEL BALLAY**: Krupp's disease in steels.

CHARLES PISOT: The modulo 1 distribution.

MME. HILDA GEIRINGER: Chance variables arbitrarily connected. (Convergence according to Poisson's law.)

BERTRAND GAMBIER: Jonas surface and *R* surfaces.

SERGE BACHVALOFF: Pairs of stratifiable rectilinear congruences.

Szolem Mandelbrojt: The equivalence of two classes of functions of Paley and Wiener.

Léon Brillouin: Disturbance of a problem of individual values by deformation of the boundary.

Georges Nadjakoff: A new species of permanent polarization of dielectrics.

Pierre Donzelot and Jean Barriol: The relation between Raman frequencies and interatomic distances.

Lévi Herman and Mlle. Fanny Bernstein: Remarks on the properties of photographic plates treated with aqueous or alcoholic solutions of sodium salicylate.

Henri Bizette and Belling Tsaï: The magneto-optical properties of compressed gases. The magnetic double refraction of nitric oxide. The magnetic rotatory power of helium.

François Bourion and Mlle. Odile Hun: The determination of the hydration of the ions of sodium iodide.

W. Broniewski, S. Przedpelski and S. Sulowski: Some physical and chemical properties of very pure steels. The steels were prepared from electrolytic iron and lampblack in an induction furnace, and contained less than 0·014 per cent of impurities other than carbon. Curves are given showing the variation of several physical properties as a function of the percentage of carbon.

J. Berthois and J. Furnestin: Study of the sediments dredged by the *Président Théodore Tissier*. Continental plateau (Celtic and English Channel) and the North Sea.

Léon Aufrère, Edouard Girard and Edmond Vignard: The alios of the forest of Montmorency.

Edgar Aubert de La Rüe: Contribution to the geological study of the New Hebrides.

Georges Colange and Yves Le Grand: Observation of the atmospheric image of a lighthouse.

Raymond-Hamet and Colas: The botanical origin of the Chuchuhuasha. The bark of a Peruvian plant, possessing physiological activity, locally named Chuchuhuasha much resembles *Maytenus communis*, but is regarded by the author as a new species of *Maytenus*.

Lucien Plantefol: Demonstration of the extrinsic character of oxidations induced by glucose.

Octave Duboscq and Mlle. Odette Tuzet: The fusome and crosswise cells of the calcareous sponges.

Raoul Lecoq: The influence of iodine and of some inorganic and organic iodine compounds on the bone lesions of experimental rickets. Iodine exerts a clear curative action on bone lesions of the rat with rickets experimentally produced. This action is the same whether the iodine is free or in combination.

P. Lassablière: A new property of foods, trophophylaxy.

Henri Bierry, Bernard Gouzon and Mlle. Colette Magnan: The variations in the proportion of glycogen in edible oysters.

Mme. Vera Dantchakoff: The relation between genic sexual determinism and sex.

Maurice Favrelle and Georges de Vichet: The results of impregnation, by an Algerian male, of French parthenogenetic females of *Bacillus rossii*.

Georges Champetier and Emmanuel Fauré-Frémiet: The roentgenographic study of an intracellular protein.

Mlle. Rachel Schoen: Lymphogranulomatous virus and neoplasm.

Georges Mouriquand, Henri Tête, Georges Wenger and Paul Viennois: The action of sterilization and of some modes of preservation on the antiscorbutic power of lemon juice.

Pierre Gley: The antistreptococcic action of certain organic sulphur derivatives.

Brussels

Royal Academy (*Bull. Classe Sci.*, **23**, No. 4; 1937).

L. Godeaux: An algebraic variety in three dimensions the operation of adjunction on which has the period three.

F. H. van den Dungen: Report on the legal systems of weights and measures in Belgium.

O. Rozet: A linear system of plane hyperelliptic curves.

G. Dufrane: A birational transformation of space of four dimensions with a given fundamental curve.

D. S. Mitrinovitch: A problem on the asymptotic lines of a class of surfaces.

N. Neronoff: The reduction of a plane problem in hydrodynamics to the solution of a system of functional equations.

L. Mathèwe: Note on the axial rotational periods of stars.

Elisabeth Bodson and Francine Dehalu: New researches on the bands of aluminium oxide. New bands of the ${}^2\Sigma - {}^2\Sigma$ system of AlO obtained by explosion of an aluminium wire.

P. van Rysselberghe: Application of affinity to coupled biochemical reactions. Theoretical study of some reactions produced by bacilli and algæ.

Cape Town

Royal Society of South Africa, June 16.

J. L. B. Smith: The South African fishes of the families Sparidæ and Denticidæ. Sparid and denticid fishes occur in all tropical and temperate seas, and are of very considerable economic and taxonomic significance. In South African waters, there are forty species, many of which are endemic, and some are highly specialized and unlike any from other parts. Some species occur in vast numbers and are among the most important food-fishes of South Africa. The taxonomic relationships of the species have never been fully investigated, and the whole group has stood in need of critical revision, which has now been undertaken. Very considerable changes, both taxonomic and nomenclatorial, are proposed in the present work. Illustrations of all species of which no reliable figure exists have been provided, also photomicrographs of several selected scales of most species.

A. J. H. Goodwin: Archæology of the Oakhurst shelter, George: (6) The Wilton deposit. Throughout the uppermost 3 ft. of deposit there is a single cultural continuity present. At 36 in., the culture is a normal Wilton; after this level the typical Wilton stone implements are replaced by shell implements. After 18 in. there is an increase in pebble implements. In the uppermost 9 in. pottery appears. Throughout the whole Wilton period the subsistence basis remains the same, and consists of shell-fish, sea fish, and animals of modern type.

Cracow

Polish Academy of Science and Letters, May 10.

M. Jacob: A possibility shown by Cesàro of summing developments in series of Hermite polynomials.

J. Weyssenhoff: The metric field and field of gravitation.

A. Kania: The magnetic declination at Cracow during the period 1914–36. The formula western declination $= 3{\cdot}200^\circ - 0{\cdot}160^\circ\ (t - 1925)$, t being expressed in years, obtained by the method of least squares, reproduces the observations, 589 in number, with a mean quadratic error of $\pm\ 0{\cdot}093^\circ$.

H. Lachs and W. Piekielny: The oxidation of sulphur vapour at low pressures.

G. Birstein and M. Blumenthal: The kinetics of the phenomenon of crystallization.

B. Kamienski: Superficial phenomena and the dissociation constant of weak electrolytes.

F. Gorski: Researches on the utilization of the optical antipodes of racemic acid by *Aspergillus fumigatus*.

B. Swiderski: The fauna of the Jurassic Klippes in the Czarny Czeremosz basin.

J. Wilburg: The survival, at a temperature of 38° C., of the tissues of the embryo of a fowl after its death.

Mme. I. Mikulska: Comparative study on the biology and metamorphosis of the larvæ of the genus *Catocala*.

J. Marchlewski: The hybrids of guinea fowl (*Numida meleagris*) and a domestic cock (*Gallus domesticus*) obtained by artificial impregnation.

H. Szarski: The vessels of the thymus of some tail-less batrachians.

S. Skowron, Z. Wicinski and S. Zajaczek: Observations concerning the result of defect or excess of the thyroid hormone in the maternal organism on thyroid body of the fœtus, and notes on the effect of partial extirpation of the parathyroid glands on parturition.

Moscow

Academy of Sciences, (*C.R.*, 14, No. 9; 1937).

L. Kantorovič: (1) The moment problem for a finite interval. (2) Some theorems on nearly complete convergence.

K. Presidskij: A theorem of Liapounoff.

G. M. Kovalenko: Influence of carbon tetrachloride vapour on breakdown voltages of air.

D. I. Mirlis: Kinetics of wetting and linear corrosion of metals in polyphase systems: metal-liquid-liquid, and metal-liquid-gas (2).

V. O. Mochnač and V. S. Bagniuk: The action of the halogen compounds of arsenic and phosphorus on ethinecarboxylic acids (1). Addition reaction of arsenic chloride with tetrolic acid.

V. O. Mochnač and A. I. Stoliarov: Geometrical isomerism of halogen-substituted ethene acids. (2) Addition of hydrogen bromide to tetrolic acid.

N. S. Voronets: The existence of the Upper Triassic in the region of the Bureya River basin.

A. S. Serebrovsky: The third variant in the 'triangle method'.

V. I. Patrušev: Inheritance of biochemical characters by animals, and its relation to their growth. (1) Glutathione concentration in the blood and difference in size of breeds of farm animals. (2) The catalase content of the blood of horned cattle and of sheep.

Vienna

Academy of Sciences, June 10.

J. Kisser and K. Lohwag: Histochemical study of lignified cell walls. The early wood of firs is much more resistant to chemical attack than the late wood, and the radial cell walls of the latter are more resistant than the tangential walls.

O. Ried: Influence of irradiated metal compounds on the growth and development of *Phaseolus vulgaris* L. Copper sulphate and sulphide lose their property of inhibiting growth when irradiated with ultraviolet light. The property of bacon fat of stimulating growth is increased by irradiation, especially in the presence of zinc oxide.

A. Malabotti: Action of β-indole-acetic acid on plants (2). Influence of growth-promoting substance on the cotyledons of *Phaseolus vulgaris* L.

J. Jurišić: Action of β-indole-acetic acid on plants (3). Action of heteroauxin on foliage leaves and cotyledons.

L. Portheim: Action of β-indole-acetic acid on plants (4). Studies with buds of *Phaseolus vulgaris* L. The curvatures produced in leaves when drops of heteroauxin are placed on different parts are studied.

E. Rouschal: Velocity of the transpiration current in maqui wood.

A. Erdélyi: Theory of confluent hypergeometric functions of several variables.

A. Kailan and F. Hartel: Velocity of catalytic hydrogenation of oleic and cinnamic acids.

H. Dostal: Kinetics of thermal polycondensation reactions.

H. Lachs and A. I. Grosman: Viscosity of cuprammonium solutions of cellulose.

D. Balarew and N. Kolarow: Vapour pressure and the size of drops.

M. Mladenovic: Elemic acid from manila-elemi (9). Dihydroelemolic acid.

K. Przibram: Correction to the paper of I. Leitner "Quantum Yield in the Coloration of Rock Salt by X-, γ- and β-Rays".

O. Schindler: A new species of fish (Characidae) from north-east Paraguay.

June 17.

A. Köhler and A. Marchet: Recent volcanic rocks in the Lainzer Tiergarten in Vienna.

P. and E. Krumholz: Diphenylcarbazone. Pure diphenylcarbazone has been prepared from the substance erroneously referred to by this name in the literature.

P. Krumholz and H. Watzek: Autoxidation of diphenylcarbazone. Autoxidation is accelerated by traces of copper. The effect is highly specific and can serve for the quantitative estimation of minute traces (10^{-7} mol/litre) of copper in solution.

K. Graff: (1) Estimation of colours of stars in large instruments. (2) Red cloud and distribution of stars round δ, ε, ζ Orionis.

Berta Karlik and K. Przibram: Fluorescence of divalent rare earths.

W. Salomon-Calvi: Continuation of the clay line in Asia Minor.

A. Rollett: Azocolours (3).

R. Skrabal: Studies of the Raman effect (73). Derivatives of cyclic compounds with three and four atoms in the ring.

J. Löbering and K. P. Jung: Kinetics of polymerized aldehydes.

O. Brunner and W. Kleinau: Material of the retina (5). Isolation of vitamin C from the retina.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT CLINICAL PATHOLOGIST in the Preventive Medicine Department Laboratories of the University of Bristol—The Secretary (August 28).

ASSISTANT IN AGRICULTURAL ZOOLOGY in the University of Aberdeen—The Secretary (September 1).

ASSISTANT LECTURER AND DEMONSTRATOR IN ZOOLOGY AND COMPARATIVE ANATOMY in University College, Cardiff—The Registrar (September 3).

ASSISTANTS (grade III) in the Meteorological Office—The Secretary (S.2.A.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (September 7).

DEMONSTRATOR IN BIOLOGY in the Royal Veterinary College and Hospital, Camden Town, London, N.W.1—The Secretary (September 7).

SECRETARY to the Institution of Civil Engineers—The Chairman of the Selection Committee, Institution of Civil Engineers, Great George Street, Westminster, S.W.1 (November 1).

JUNIOR SCIENTIFIC OFFICER (PHYSICIST) at the Fuel Research Station, Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16, Old Queen Street, London S.W.1 (quote *J*. 37/11).

Official Publications Received

Great Britain and Ireland

British Non-Ferrous Metals Research Association. Research Reports Association Series, No. 449: Creep of Non-Ferrous Metals and Alloys; a Review of Published Information. By W. A. Baker. Pp. 19. (London: British Non-Ferrous Metals Research Association.) 2*s*. [217

Report of the Harper Adams College Advisory Department, April 1936—March 1937. (Advisory Report, No. 12.) Pp. 23. (Newport, Shropshire: Harper Adams Agricultural College.) [227

Forestry Commission. Seventeenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1936. Pp. 42. (London: H.M. Stationery Office.) 9*d*. net. [227

International Lighthouse Conference, Berlin, 1937. Coloured Glass for Lighthouse Purposes. By J. G. Holmes. Pp. 53. (Smethwick: Chance Brothers and Co., Ltd.) [237

Technical Publications of the International Tin Research and Development Council. Series A, No. 55: The Determination of Cadmium in Tin-Rich Alloys. By Prof. D. Hanson and Dr. W. T. Pell-Walpole. Pp. 6. Free. Series A, No. 56: The Electrodeposition of Tin from Acid Sulphate Solutions. By A. W. Hothersall and W. N. Bradshaw. Pp. 16. Free. (London: International Tin Research and Development Council.) [237

Research Association of British Rubber Manufacturers. Seventeenth Annual Report for the Year 1936. Pp. 86. (Croydon: Research Association of British Rubber Manufacturers.) [267

Imperial Economic Committee. Fruit Supplies, 1936, including Vegetables, Flowers and Bulbs. A Supplement to Weekly Fruit Intelligence Notes prepared in the Intelligence Branch of the Imperial Economic Committee. Pp. 108. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [287

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (the National Fruit and Cider Institute), Long Ashton, Bristol, 1936. Pp. 296. (Bristol: The University.) [287

Eighteenth Annual Report of the Ministry of Health, 1936–37. (Cmd. 5516.) Pp. x+328. (London: H.M. Stationery Office.) 5*s*. net. [48

Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 50: A Ten Years' Experiment on the Spread of Leaf Roll in the Field. By Paul A. Murphy and J. B. Loughnane. Pp. 567–580. 1*s*. Vol. 21 (N.S.), No. 51: Investigations on a Molecular Constant for Soured Milks. By G. T. Pyne and J. J. Ryan. Pp. 581–586. 1*s*. Vol. 21 (N.S.), No. 52: The Chemical Constituents of Lichens found in Ireland—*Pertusaria concreta* Nyl. form *Westringii* Nyl., by J. Breen, Dr. J. Keane and Dr. T. J. Nolan; No. 53: The Chemical Constituents of Lichens found in Ireland—*Parmelia conspersa* Ach., by Margaret Mohan, Dr. J. Keane and Dr. T. J. Nolan. Pp. 587–594. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [48

City of Leicester Municipal Libraries. Fifty-eighth Report to the City Council, 1st April 1936 to 31st March 1937. Pp. 20. (Leicester: Leicester Municipal Library.) [48

Other Countries

State of Illinois: Department of Registration and Education, Division of the Natural History Survey. Bulletin, Vol. 21, Article 2: Responses of the Large-mouth Black Bass to Colors. By Frank A. Brown, Jr. Pp. iii+33-56. (Urbana: Illinois State Natural History Survey.) [217

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 18, No. 7 (Mathematics, No. 22): Beiträge zur Geometrie der Kreise und Kugeln (18), von Sôzi Matumura; Über Flächen und Kurven (7), von Sôzi Matumura. Pp. 185–202. Vol. 18, No. 8 (Mathematics, No. 23): On a Pair of Surfaces mutually Related (6). Von Sôzi Matumura. Pp. 203–214. Vol. 18, No. 9 (Mathematics, No. 24): Über Flächen und Kurven (18). Von Sôzi Matumura. Pp. 215–228. (Taihoku: Taihoku Imperial University.) [227

Hyderabad Geological Series. Bulletin No. 2: A Brief Outline of the Geological History of Hyderabad State, with a Reference to its Mineral Resources. By Khurshid Mirza. Pp. iii+58. (Hyderabad: Geological Survey Department.) 1 rupee. [227

United States National Museum. Bulletin 153: Birds collected by the Childs Frick Expedition to Ethiopia and Kenya Colony. By Herbert Friedmann. Part 2: Passeres. Pp. xii+506+14 plates. (Washington, D.C.: Government Printing Office.) 70 cents. [237

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 22, No. 4: No. 33, The Hemiptera of the Templeton Crocker Expedition to Polynesia in 1934–1935. By E. P. Van Duzee. Pp. 111–126. (San Francisco: California Academy of Sciences.) [237

Regenwaarnemingen in Nederlandsch-Indië. Zes en vijftigste Jaargang, 1934. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [237

Nyasaland Protectorate: Geological Survey Department. Colonial Development: Water Supply Investigation—Progress Report (No. 6) for the Year 1936. Pp. 15+2 maps. (Zomba: Government Printer). [267

Union of South Africa: Department of Irrigation. Magnetic Declination in South Africa (1936) published in connection with the Isogonic Magnetic Map of South Africa, south of Latitude 18° S. for the approximate Epoch, April 1936, particularly of the Union of South Africa. By A. D. Lewis. Pp. 19+2 plates. (Pretoria: Government Printer.) 2*s*. 6*d*. [267

Southern Rhodesia: Geological Survey. Bulletin No. 30: The Geology of the Country Around the Queen's Mine, Bulawayo District. By A. M. MacGregor, J. C. Ferguson and F. L. Amm. Pp. vi+175+20 plates. (Salisbury: Government Stationery Office.) 5*s*. 6*d*. [267

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 72, Abh. 2: Beiträge zur Osteogenese des Knochensystems beim Haushuhn, bei der Haustaube und beim Haubensteissfuss; eine vergleichend *osteologische Studie. Von Hans R. Schinz und Rainer* Zangerl. Pp. iii+117–165+4 plates. (Zürich: Gebrüder Fretz A.-G.) [267

Geological Survey of Uganda. Memoir No. 3: The Volcanic Area of Bufumbira. Part 2: The Petrology of the Volcanic Field of Bufumbira, South-West Uganda. By Prof. Arthur Holmes (Petrology), and Dr. H. F. Harwood (Chemical Analyses). Pp. xiv+300+5 plates. (Entebbe: Government Printer.) 21*s*. [267

Memoirs of the Geological Survey of India. Vol. 71: The Geology of Gangpur State, Eastern States. By Dr. M. S. Krishnan. Pp. vii+181+xviii+19 plates. (Calcutta: Geological Survey of India.) 6.12 rupees; 11*s*. [267

Royal Agricultural Society, Egypt. Technical Bulletin No. 30: Experiments in Egypt on the Interaction of Factors in Crop Growth. 6: Further Experiments on the Nitrogenous and Phosphatic Manuring of Cotton. By Frank Crowther, Adolf Tomforde and Ahmed Mahmoud. Pp. 56. (Cairo: Royal Agricultural Society.) [277

Annales Bryologici: a Year-Book devoted to the Study of Mosses and Hepatics. Edited by Fr. Verdoorn. Vol. 9 (1936). Pp. iv+160. (Leiden: Chronica Botanica Co.; London: W. Dawson and Sons, Ltd.) 6 guilders. [48

Smithsonian Institution: United States National Museum. Bulletin 168: Nearctic Collembola or Springtails, of the Family Isotomidae. By J. W. Folsom. Pp. iii+144+39 plates. (Washington, D.C.: Government Printing Office.) 30 cents. [48

Bulletin of the American Museum of Natural History. Vol. 73, Art. 6: Catalogue of the Meteorites in the American Museum of Natural History as of October 1, 1935. By Dr. Chester A. Reeds. Pp. 517–672. Vol. 73, Art. 7: The Sense Organs involved in the Courtship of Storeria, Thamnophis and other Snakes. By G. K. Noble. Pp. 673–725. (New York: American Museum of Natural History.) [48

U.S. Department of Agriculture. Circular No. 433: Crow—Waterfowl Relationships, based on Preliminary Studies on Canadian Breeding Grounds. By E. R. Kalmbach. Pp. 36. 10 cents. Circular No. 436: Production and Agricultural Use of Sodium Nitrate. By Albert R. Merz and C. C. Fletcher. Pp. 12. 5 cents. (Washington, D.C.: Government Printing Office.) [48

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 57: The Amphibia of Connecticut. By Lewis Hall Babbitt. Pp. 50+20 plates. (Hartford, Conn.: State Geological and Natural History Survey.) [48

Industrial Research Bureau. Bulletin No. 10: Indian Vegetable Oils. By N. Brodie. Pp. viii+116. (Delhi: Manager of Publications.) [48

Annual Report of the Imperial Dairy Expert for the Year 1935–36. Pp. ii+24+6 plates. (Delhi: Manager of Publications.) 1.4 rupees; 2*s*. [48

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 14: A Preliminary Study of Root Characters as affecting Drought Resistance in Two Sugarcane Varieties and in their Seedlings. By Dr. H. Evans. Pp. 20. (Port Louis: Government Printer.) [48

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 153: The Moment of the Fluid Pressure acting on a Flat Plate in a Semi-infinite Stream bounded by a Plane Wall. 2: Case of Upper Boundary. By Susumu Tomotika and Isao Imai. Pp. 473–517. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 50 sen. [48

Smithsonian Institution: Bureau of American Ethnology. Bulletin 114: Fox Miscellany. By Truman Michelson. Pp. v+124. (Washington, D.C.: Government Printing Office.) 25 cents. [48

Catalogues, etc.

Edwards' Vacuum Pipe Line Installations. Pp. 8. (London: W. Edwards and Co.)

Polaroid and Polarised Light. By Prof. A. F. C. Pollard. Pp. 24. (London: Polaroid Products, Ltd.) 1*s*.

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International Co-operation in Science

THE organization of international co-operation must in the nature of things be very different in different branches of science. Thus in astronomy, where no one country can cover the whole of the heavens or observe the sun continually through the twenty-four hours of the day, progress in many branches of statistical and even observational astronomy must depend on observers working in many countries of the globe on mutually agreed programmes. In geodesy the shape of the earth can only be determined with the highest possible accuracy by the survey of long arcs passing through a number of countries. Meteorology, geography and radio-science similarly present obvious examples where international agreements can alone secure the maximum of beneficial results from separate sets of observations and from instrumental and theoretical developments.

On the other hand, in sciences such as physics, chemistry and the biological sciences, where most developments come from the individual investigator and his team of co-workers, the value of international organization is less obvious, being limited at first sight to such important questions as the definition of standards or agreements on nomenclature. These have become the care of International Unions or International Congresses. The organized Union is to be preferred for such work to the Congress, as its framework is on the whole more suited to the maintenance of permanent committees. Both Unions and Congresses fulfil one further purpose of great value in bringing together periodically for discussion and mutual intercourse fellow-workers from many scattered lands, studying a group of cognate subjects. A similar service on a more limited scale is served by the gatherings of specialists in a given field of work held from time to time at various academic centres.

The International Council of Scientific Unions, heir to the old Association of Academies, serves as a link between the chief scientific bodies of the nations and also as a link between the various International Unions that adhere to it. One of its most useful tasks is to organize committees for the study of problems in which a number of Unions are interested: the Committee on Solar and Terrestrial Relationships examines just such a set of problems; the Unions of Astronomy, of Geodesy and Geophysics and of Radio-Science are all interested in its work and nominate members to serve on it.

The International Council may be said to approach the question of international co-operation from the side of the Unions. Another body, the Organisation Internationale de Co-opération Intellectuelle de la Société des Nations, working through its committee of scientific experts, has had quite another line of approach. It may be said to look at scientific questions from the points of view of those familiar with the problems that daily face the League of Nations. Thus the question of organizing help for scientific bodies of undoubted international value that for financial reasons find themselves unable to continue with their work comes naturally to the Organisation. Or again, the publication of important learned papers in languages not widely diffused in the world—a question of importance to scientific workers but not to them alone—has been studied by the Organisation, and a solution is more likely to be reached by the channels to which it has access than by individual Unions or Congresses or even the International Council. The same is true of the question of unauthorized translations of scientific work, and of the co-ordination of funds available in different countries for special researches—a co-ordination necessary in order to avoid unnecessary or undesirable overlapping.

After some years of negotiations, the International Council of Scientific Unions and the Organisation Internationale de Co-operation Intellectuelle have come to an agreement to work together in the several tasks which they face—not as one body but as two bodies in close touch with each other. Last month, in Paris, at a joint meeting of the two bodies (see NATURE, July 17, p. 121), Prof. Ch. Fabry and Sir Gilbert Murray signed an agreement which lays down the method of co-operation of the two bodies, the respective spheres of action being broadly along the lines indicated above. Purely scientific questions will go to the Council, which will work through its constituent Unions: questions of a primarily international nature will be referred to the Organisation. At a recent meeting of the General Assembly of the International Council a proposal was made for the appointment of a committee on the relation of science to the life of the community. It was pointed out that in its original form this motion covered a field lying beyond the purview of the Council. In the amended form which was adopted, the work of the Committee, which has now been appointed (see p. 358), was limited to the scientific side of the question. The more political side may be taken up elsewhere, and represents the kind of question that may fall to the Organisation to study.

There remain gaps on both sides. Subjects—geology and mathematics may be mentioned—lie outside the range covered by the Council; countries stand aloof from the League of Nations. Still, the *rapprochement* between the two bodies can but strengthen both and may lead to more active co-operation between them and those other bodies which stay outside, though each is carrying out work of similar purpose in its own branch of science.

Native Science in Southern Sudan

Witchcraft, Oracles and Magic among the Azande

By Dr. E. E. Evans-Pritchard. Pp. xxx + 558 + 34 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 21*s*. net.

DR. E. E. EVANS-PRITCHARD, already well known in anthropological circles for some penetrating studies of the manners, customs and mental constitution of certain peoples of the Anglo-Egyptian Sudan, has by this book placed himself in the front rank of British anthropologists. Europeans who have visited primitive people have always been attracted by the notions which they think they have found concerning witchcraft, oracles and magic; but most of them have attempted to interpret these notions mainly in the light of their own, or what they consider to be their own, habits of thought. Consequently, these topics have been treated as if their main interest lay in their curiosity, their oddity; and not infrequently they have been taken to indicate that there is some sort of primitive logic exceedingly different from that of the Western world. Dr. Evans-Pritchard is no mere curiosity hunter; he realizes that many of the Azande notions about witchcraft, and the ways in which the people use them, are not far removed from some of our own current ideas and practices about medicine and the chances of life; and he knows perfectly well that though his book is entirely concerned with witches, witch-doctors, magicians and sorcerers, it covers only a very small part of Azande activity: "Most of their talk is common-sense talk, and their references to witchcraft, whilst frequent enough, bear no comparison in volume to their talk about other matters".

The Azande are a fairly numerous people living on the Nile-Congo divide. At present they form a homogeneous group, but they were formerly of many different tribes, with a variety of languages and institutions. As is natural, in such circumstances differences of social status play a great part in Zande culture. In particular, while the general rank and file are easily accessible, sociable, good-natured, assimilative, the royal class remain aloof, conservative, superior.

"Every Zande is an authority on witchcraft." If anything unusual happens, especially anything of an unfortunate character, it is attributed to some person—less often to some animal—in whom witchcraft resides as an inherent quality. This person does not need to do anything special in order to exert his influence; in fact, he cannot well help himself, for within him, whether he knows it or not, is some "witchcraft substance". Dr. Evans-Pritchard has himself never seen this substance, but it can be discovered by autopsy, and the evidence leads him to believe that it is the small intestine at a certain phase of digestive process.

Anyway, whatever it is, it is hereditary, and since it is a part of the body, it grows with the body, and becomes more potent as its possessor grows older. It can threaten misfortune, and then may be counteracted in various ways through the co-operation of oracles. It may produce death, and then must be avenged, though very little appears to be known about the precise operation of vengeance-magic.

In the early parts of his book, Dr. Evans-Pritchard describes, with copious illustration, what witchcraft is to the Azande, what sorts of things it can do, and what socially controlled processes there are for taking precautions against its more disastrous effects. It provides for these natives a kind of "natural philosophy by which the relations between men and unfortunate events are explained", and it gives them a "ready and stereotyped means of reacting to such events". So there is no kind of contradiction if a man treats a festering wound as due to witchcraft, and at the same time treats the wound as due to a spear or a splinter. Equally there is no contradiction if he should say that a death is caused by a weapon in some particular place, and at the same time by witchcraft in some other place. A good many Europeans have wished to verbalize all these actions or attitudes, and then to show that the different statements made together are mutually incompatible, and to prove from this that the native mind works in some manner peculiar to itself. But Dr. Evans-Pritchard puts the truth perfectly clearly : "We have to be careful to avoid in the absence of native dogma constructing a dogma which we would formulate were we to act as the Azande do. . . . The Zande actualizes his beliefs rather than intellectualizes them, and his tenets are expressed in socially controlled behaviour rather than in doctrines. . . . His ideas are imprisoned in action and cannot be cited to explain and justify action".

A person who is in a line of witches is probably inhabited by witchcraft ; but he need not worry overmuch about that. Anybody can be a witch, and so he can live comfortably, respected, and even somewhat admired by his neighbours. A Zande who is worried about his health will go off to consult an oracle in the socially approved way. He may be a little downcast until he has taken the necessary steps to render the witchcraft quiet, but this is unlikely to carry him into downright illness. Also, contrary to the sort of opinion which has been expressed in some quarters, these people, at any rate, are no more likely to be thrown into a variety of mental disorders by their beliefs about ubiquitous witches than are most people in our own community when they read newspaper reports of road-accident statistics. The Zande, indeed, "is never so happy as when he is consulting the poison oracle, and he easily banishes all other considerations from his mind when he is engaged upon this task of supreme interest". For him it is clearly as good as a visit to Harley Street is for many of us. Dr. Evans-Pritchard shows, moreover, the social value of many of the controlled methods for the consultation of oracles, as well as of the ways in which such practices may be abused. Destroyed for ever, in this case, at any rate, is the picture that when a people talk often about witchcraft and its potency for misfortune, they must be miserable, hag-ridden, harried and hunted by malevolent forces. They can be as curious, and, in their ways, as knowledgeable as anybody, about the sequences of natural events ; and, when they come to the other questions about why certain sequences happen when they happen, they can get from their witch philosophy the same sort of satisfaction that others find in 'chance', or 'probability', or in different beliefs more dogmatically formulated.

In Part 2 of his book Dr. Evans-Pritchard considers witch-doctors ; that is to say, the specialized profession among the Azande who have "vested interests in the knowledge of medicines" and are consulted when witchcraft is suspected. The witch-doctor is a diviner, exposing witches, and a magician, thwarting them. Here, if possible, the book becomes more interesting still. The topics discussed are : how the witch-doctor conducts his *séance*, what is the basis of Azande belief in the witch-doctor, how the novice is trained in the art, and the place of the witch-doctor in Zande society. The accounts of the technique of the doctor, of how he maintains his social prestige, of the ways in which he elicits just the sort of information which his vocation requires, of the skill with which he often meets individual desire and need and satisfies important social demands are both convincing and delightful to read. Anyone who has talked with witch-doctors in an African community, as I have done, and watched them at work, will be interested to find that Dr. Evans-Pritchard was "impressed with their ability" and that he thinks it probable "that as a rule men who show a strong desire to become witch-doctors have a higher degree of intellectual curiosity and greater social ambition than the ordinary Zande possesses". In view especially of the great amount of administrative trouble which has arisen in many parts of the British Empire owing to the adoption of purely repressive measures against the diviner and magician, it is particularly to be hoped that people responsible, directly or indirectly, for the government of native races will read and seriously consider this part of the book.

Dr. Evans-Pritchard next discusses various practices connected with oracles, their collection and use, and deals finally with magic and sorcery, with some comments also upon native leechcraft. It appears that of late a number of associations have developed among the Azande for the practice of magic in assemblies. One of these is described in considerable detail, and it is demonstrated how a specific organization may be used to introduce new ideas and to spread them throughout the community, although the ideas themselves may have a much wider application than the avowed purpose of the organization would seem to imply.

Dr. Evans-Pritchard modestly hopes that his book will "be of service to political officers, doctors, and missionaries in Zandeland, and later to Azande themselves". If they will read it, it certainly will be of service to all of these ; but it will also be of wider value than this. Every social anthropologist should study it, not only for the wealth of information which it contains, but also as a model of well-controlled and sane methods of investigation. Everybody interested in the development of primitive science and the ways in which other minds than our own attempt to explain natural processes should read it, for it will correct a mass of popular and third-hand speculation concerning these matters. Further, everybody who is practically interested in native administration anywhere throughout the British Dominions ought to read it, for it will help him to understand the core of many difficult administrative problems and to solve them with a minimum of disastrous friction.

F. C. BARTLETT.

Chemical Stabilization

The Retardation of Chemical Reactions
By Prof. Kenneth C. Bailey. Pp. viii+479. (London: Edward Arnold and Co., 1937.) 26*s*. net.

THE problem of the supply of drinking water to troops sent to tropical stations was extremely difficult during the early part of the Great War. For removing the excess of chlorine used in sterilizing water, hydrated sodium sulphite was dispatched to places like Basra, Bagdad, etc., where the temperature goes up to 118° F. (48° C.) in the shade in summer. It frequently happened that by the time the sodium sulphite reached its destination, it was wholly converted by oxidation into sodium sulphate, which was useless as an 'antichlor'. Hence investigations were carried on to discover stabilizing agents or retarders of the oxidation by air of sodium sulphite. Hydroquinone (quinol) and other organic compounds when added even in traces were effective in preserving sodium sulphite from such oxidation.

Sodium sulphite, which is a valuable material in photography as well, and other useful substances like vitamins, butter, fats, cod liver oil, rubber, petrol, ether, chloroform, hydrogen peroxide, acrolein, and so on, are stabilized on a commercial scale against oxidation, polymerization, decomposition, etc., by the addition of chemicals, which in general can themselves combine with oxygen. The use of acrolein as a poison gas led the late Prof. Moureu and Prof. Dufraisse to study its stabilization by different reagents.

Not only is the subject of importance to chemists and industrialists, but physiologists also know that fats and especially carbohydrates act as protein economizers in the animal body. Moreover, carbohydrates, pentosans, cellulosic materials, etc., when added to soil, cause nitrogen fixation and also preserve the soil nitrogen from too rapid oxidation and loss.

Prof. K. C. Bailey has collected the literature on the subject and has ably discussed it from the theoretical and practical points of view. After a brief account of the historical development, the author takes up the oxidation of phosphorus and the combination of hydrogen and oxygen. A number of retarders for both these reactions have been known for some time. He considers the mechanism of these oxidations from the point of view of the chain theory and goes on next to the oxidation of hydrocarbons and other compounds. This is followed by an excellent account of the work of Moureu and Dufraisse, who have given a great impetus to research in the retardation of oxidations. The slowing down of the oxidations of inorganic substances like sulphites, arsenites, antimonites, ferrous, stannous, cuprous salts and organic compounds like aldehydes, chloroform and other halogenated substances, adrenaline, carbohydrates and allied compounds, dyestuffs, etc., has also been discussed. It is interesting to note that the rancidity of butter, cod liver oil and similar substances is chiefly due to their partial oxidation by air, and many reducing agents such as hydroquinone and pyrogallol even in traces retard this oxidation and delay rancidity.

In recent years, 'anti-knock' compounds and their function in motor-car engines have been extensively studied, and Prof. Bailey has given an adequate account of this work with the various theories that have been put forward to account for it. Existing theories appear to be inadequate, and further work is necessary.

The protection of rubber from deterioration, the preservation of hydrogen peroxide from decomposition and the prevention of metallic corrosion are also considered in this book. The function of retarders in the setting of plaster-of-Paris and cement is also discussed.

In the last portion, the decomposition of numerous organic and inorganic compounds, the reactions of halogens with hydrogen and other reducing agents and the retardation by water in the processes of esterification, saponification, hydrolysis and the decomposition of organic substances by concentrated sulphuric acid, have been summarized. A brief account of the quenching of fluorescence and the after-glow of active nitrogen has also been included. There is a bibliography of 1,630 original papers at the end of the book.

The subject-matter of this book is of considerable practical and theoretical importance. Prof. Bailey's discussion of the diverse topics involved is clear and exhaustive, and presented in a very readable form. The book should be valued and widely read.

N. R. DHAR.

Reflections on Life

Life Here and Now:
Conclusions Derived from an Examination of the Sense of Duration. By Arthur Ponsonby (Lord Ponsonby of Shulbrede.) Pp. 289. (London: George Allen and Unwin, Ltd., 1936.) 10*s*. 6*d*. net.

THIS rather unusual book of reflections on life not only gives us in effect an interesting portrait of one of our greatest authorities on the type of data which characterize the 'commonplace book', but also an unexpected plea for individual action in support of high ideals, whether of peace or of social reform. Lord Ponsonby has long been occupied with thought on the nature of time and on our appreciation of its meaning and value in the art of living. He now advances a general argument based on an analysis of the sense of duration, and relying on the scientific attitude of Huxley's generation, he tilts valiently at organized religion as he conceives it. The idea of personal immortality is challenged, and its rejection appears to be inspired largely by his contention that too much time is occupied in vain speculations about the future to the neglect of the present.

If Lord Ponsonby appears to overstress the logical part of man's nature, there is nothing in this finely written plea for more effective use of the immediate moment to control the duration of our living which can possibly impede that *rapprochement* between science and religion for which Smuts and others have been pleading. Not even those whose convictions he brushes on one side—not always on the most convincing grounds—can fail to recognize the dignity and sincerity of his plea for a better use of our present term, of the proper use of the new in the here, of the moment as it passes in our own environment. He gives us wise words on the small matters which make up the art of living, but most will welcome the book for its inspiring idealism. Planning the future, he claims, is better for the mind than analysing the past, and if he is impatient with creeds it is perhaps mainly in so far as they impede progress.

Lord Ponsonby believes in individuality, and nowhere is this clearer than in his plea for a courageous stand for peace. "Our forefathers certainly would be unable to discover any element of glory in modern warfare; but they would observe in the world a noticeable depreciation of the value of human life." The warm human sympathies of the writer are as conspicuous as the sincerity of his thought and the lucidity of his diction, and they lead him to a final plea for action and service which is poles asunder from the frenzied plea of the demagogue to "do something". Its calm and dignified courage should win the sympathy of all who appreciate the inspiring personality imprinted upon that plea: "*Now* is the greatest of moments, the most real thing of which we can be aware. . . . To seize it as an opportunity means bracing ourselves up for action, decision, bite, endeavour . . . not vague resolutions but insistent occupation, not irresolute hopes but intent purposes, not languid aspirations but ready service, not 'Time will tell', but 'I will tell Time' . . . the errors of impetuosity are far less serious than the errors of caution and indolence and the enervating paralysis of procrastination. . . . There is no failure except in leaving off trying."

These are no pages from a dilettante's notebook, but a glimpse into the soul of one who has made time his servant, and himself compelled the hours to suit his intentions, the minutes to serve his purpose.

R. BRIGHTMAN.

Trade Marks in India

The Law of Trade and Merchandise Marks in India
By Dr. S. Venkateswaran. Pp. lxxx + 767. (Madras: Madras Law Journal Office, Mylapore; Calcutta: Law Book Co., 1937.) 20 rupees.

THE year in which an amending Trade Marks Bill is passing through Parliament in England is singularly appropriate for the appearance of a book on trade marks in India. The book is not only in itself an excellent and comprehensive guide to English trade mark law, but is also a most powerful argument for the trade mark legislation in India that its author desires. The position to-day in India is very much the same as it was in England before 1875; the owner of a trade mark can only attempt to protect his rights by a cumbrous passing-off action or by invoking the Indian Merchandise Marks Act, under which the onus is on him to prove his entitlement, and a successful action can give him neither damages nor an injunction.

Simplicity and a reasonable degree of certainty can only be attained by direct trade mark legislation, for which there has been a demand since 1877. Mr. Venkateswaran, the author of the work under notice, an examiner in the Indian Patent Office, has a melancholy tale to tell of the abortive efforts that have been made to secure such legislation. Agreement on the need has not been accompanied by agreement on the method, and India, unable to join the International Union for the Protection of Industrial Property, by reason of the absence of trade mark legislation, has only privately run registers to show as the result of sixty years of persuasion, petition and argument by chambers of commerce and other interested bodies in India and the United Kingdom.

One of the great difficulties about trade marks is to be found in the fact that they are dealt with in most countries by the same Government department that handles patents. This encourages the idea that the two forms of protection are closely parallel. In fact, patents and trade marks have considerable fundamental differences, which were not clearly realized, for example, in the United States, for the greater part of the nineteenth century. The delay in getting adequate legislation in India will be regarded less harshly when it is realized that, in the United States, Thomas Jefferson was recommending trade mark legislation so early as 1791, and not until 1905 was there water-tight legislation there, a first Act of 1870 having been declared, *more Americano*, unconstitutional.

Mr. Venkateswaran, who is completely up to date, has a good deal to say about the Goschen Committee on Trade Marks, the report of which, issued in 1934, forms the basis for the English Trade Marks Bill. He is not only in favour of Indian trade mark law following the British model in general but also advises, with a varying degree of insistence, the adoption of most of the recommendations of the Committee. He approves, for example, of assignment in gross, but is doubtful of the applicability of Clause 8 to India, feeling that, in her present state of industrialization, abuse might arise there if the names of "registered users" as well as those of the actual proprietors could be entered on the register. Nor is he altogether happy about the marks, introduced in England in 1905 and used to indicate certification by some competent authority of the origin, material, accuracy, etc., of goods so certified. On one point, the division of the Trade Mark register into Part A and Part B, he advises a clean breakaway from English practice. He feels that the effective demand for Part B is relatively small in Great Britain, and in India can be ignored. But he goes further and states that the difference between the requirements for the two parts is neither clear nor well-explained by the English courts, and refers in support to Mr. Justice Romer's remarks in the "Liverpool Cables" case to the effect that it was doubtful whether there was any difference between "adapted to distinguish" and "capable of distinguishing", and that if a mark did in fact distinguish, it should be adapted to distinguish.

Cotton marks, for very obvious reasons, are of the first importance to India, and Mr. Venkateswaran has very definite views about the shape that relevant Indian legislation should take. He would allow the registration of word marks for cotton goods but not that of line headings. He quotes with approval in connexion with word marks some of the rules of the Bombay Mill Owners' Association, which has a register of trade names, but suggests that the exclusion of the names of gods, goddesses and mythological persons from this private register is definitely on the harsh side and sets an example not to be followed when an official register is set up.

There should be no disagreement about the need for trade marks legislation in India, and there should be the minimum of discussion before it is decided that the legislation must be on a purely

Federal and not on a States basis, the experience of the United States alone being quite sufficient to make a decision in favour of a strictly central system inevitable. Sufficient has been said, however, to show that there will be considerable debate on detail and even on certain major points of principle before trade mark India leaves the 'law-less' company of Monaco, Sarawak and the Solomon Islands and is able to take her place as a full member of the International Union.

When active consideration of prospective legislation for India does take place, it is inconceivable that Mr. Venkateswaran should not be called into consultation, for his book shows him to have both a masterly grasp of principle and a keen perception of detail. Sir Courtney Terrell, chief Justice of the Patna High Court, says in an introduction to the book that it astonished him to find "that legal principles should be so admirably expounded by one who is not a professional lawyer" and reinforces from his wide experience at home and in India the author's demand for action to end the chaos that exists in a country where no action for infringement of a trade mark can lie and the actual form of action possible—and the decision—may vary from one provincial court to another.

In a work which was merely an industrious compilation, the fact that there were some two thousand five hundred actions listed in the table of cases would normally go to show the practitioner that the book was worth acquiring. It is mentioned here only to indicate that though Mr. Venkateswaran has produced a powerful large-scale propaganda document, he has at the same time written a first-class text-book very suitable for the Indian and far from being unsuitable for the English student.

A Survey of Psychopathology

Modern Discoveries in Medical Psychology
By Dr. Clifford Allen. Pp. x+280. (London: Macmillan and Co., Ltd., 1937.) 8*s*. 6*d*. net.

DR. CLIFFORD ALLEN gives a general survey of the recent history of psychopathology suited for the medical man or the intelligent layman. He rehabilitates Mesmer as an honest worker whose results, though given a wrong explanation, were nevertheless worthy of that investigation which was denied them. He might have shown the parallel between Mesmer and Charcot, for the latter's results were genuine but misunderstood phenomena, the anatomical nervous system taking the place of Mesmer's magnetism in a spurious explanation.

Janet's work, with his theory of dissociation of consciousness, prepared the path for Freud, and to this period belong Morton Prince's studies of multiple personality. The description of the gradual nature of Freud's discoveries helps to their understanding, though the necessary condensation of material does rather less than justice to this important stage of development. Dr. Allen defends the use of what he perhaps wrongly calls mechanistic devices and mental mechanisms, by which he means those theoretical constructions giving a spatial and dynamic view of mental processes. One might, however, object to the personification by which the superego "can still wreak its revenge on the patient by making him have a terrible sense of guilt, and sometimes compel him to do something for self-punishment".

The author is fair towards Adler's theories, but, like everyone with practical experience of analytical procedure, finds them incomplete and unsatisfying, though clinically useful because of their easier demands and avoidance of emphasis upon sexuality. Jung receives credit for his work on psychological types, but the author accuses him of spoiling the technique of Freud "by the addition of a hotchpotch of religion and mythology which cannot act in any other manner than as suggestion".

Kretschmer and Pavlov are adequately handled, but only one phrase (on p. 277) indicates that Pavlov is by some people placed in opposition to Freud, and regarded, indeed, as having made psychology unnecessary. This opposition can be understood only by a knowledge of the historical conflicts in medicine between animists and vitalists on one side and iatro-physicists on the other, which form a continuous series with present controversies and depend not upon knowledge but upon basic differences of outlook. This is a field of interest that Dr. Clifford Allen has not approached.

The author's aim of presenting current views is efficiently carried out, but a unifying summary of the position to-day would have been welcome. There is fortunately among the younger generation of psychiatrists and psychotherapists an agreement upon certain fundamental principles which the author's scheme of presentation cannot convey to the reader. His literary style is straightforward and simple, and he has made the subject intelligible without shirking its difficulties. M. C.

A Text Book of Trigonometry:

for Colleges and Engineering Schools. By William H. H. Cowles and James E. Thompson. Pp. x + 373. (London: Chapman and Hall, Ltd., 1936.) 12*s.* 6*d.* net.

So many books on trigonometry are published that, when a new one makes its appearance, especial characteristics are naturally looked for. The present volume is much larger than usual, but it surveys a wider field as the course is intended to be a preparation for the study of higher mathematics, physical science and engineering. The authors state that several new and unique features are developed in the presentation of the subject, and this claim is well substantiated, for the fundamental principles of trigonometry are not dealt with in a piecemeal fashion so common in many books. Circular functions are, for example, defined generally at the beginning; radian measure, too, is introduced at once and used throughout the course. The discussion of complex numbers, expansions in series and general analytical trigonometry is not only thoroughly sound, but also is more interesting and complete than is usual. Two chapters are devoted to the manifold applications of the subject to surveying, mechanics, geodesy and astronomy. Instructive chapters are also given on logarithmic computation and the use of the slide rule, whilst emphasis is rightly laid upon accuracy, precision and significant figures in all numerical work. Considerable attention is also directed to the analysis of problems and the reduction of the formulæ deduced to a suitable form for numerical evaluation.

The student is provided with a large number of varied exercises to which answers are supplied, and some very useful tables are given at the end. The book is certainly well adapted to the purpose for which it was written, and reveals that trigonometry is something far more interesting than the mere solution of plane triangles.

F. G. W. B.

Moeurs et coutumes des indiens sauvages de l'Amérique du sud

Par Marquis de Wavrin. (Bibliothèque scientifique.) Pp. 656 + 16 plates. (Paris: Payot et Cie, 1937.) 60 francs.

In this impressive work of more than six hundred closely printed pages, the Marquis de Wavrin has embodied the results of fifteen years of travel and observation on five journeys of exploration among the less-known Indians of South America. He has covered a wide territory, for there is scarcely a part of the continent which he has not visited in that period; but his most entertaining and informative (in the anthropological sense) material is drawn from the various peoples of the Amazonian region. His method is anecdotal rather than systematic, except that he has classified his data into chapters according to subject, covering material culture, social organization, relations of the sexes, religious beliefs and folklore.

Although amusing and instructive enough to read, the unfortunate lack of method, by which the data from widely separated tribes are massed together without order or discrimination, makes it a source book for the delver after facts, rather than an ethnographical treatise. This is especially to be regretted as the author is an acute and careful observer. Perhaps he will conform to the suggestion made by M. de Créqui-Montfort in the preface, and produce a more formal account of his results later.

Thermodynamic Theory of Affinity:

a Book of Principles. By Prof. Th. De Donder and Prof. Pierre Van Rysselberghe. Pp. xx + 142. (Stanford University, Calif.; Stanford University Press; London: Oxford University Press, 1936.) 13*s.* 6*d.* net.

THEORIES of affinity have interested physical chemists for a considerable time; moreover, greater recognition is now being given to such concepts as aids in the interpretation of experimental results.

The book now before us represents an essentially synthetic outlook, and the introduction of the terms "uncompensated heat" and "degree of advancement of a reaction" gives the basis upon which it is written. The former expression is simply the dQ' of Clausius under a slightly new guise, the latter (ξ), however, is decidedly interesting as representing the state of a chemical system; its time-derivative is a rate, which leads at once to a criterion of equilibrium. These two quantities are combined in the fundamental hypothesis that $dQ'/d\xi$ is independent of any particular relation between the pressure, temperature and "degree of advancement" during a reaction. A detailed analysis leads the authors to identify this coefficient with the affinity.

In general, the treatment developed in these pages is suitable for obtaining straightforward solutions to problems like Le Chatelier's principle; another volume is promised, to deal with applications and numerical examples.

F. I. G. R.

Freud and Marx:

a Dialectical Study. By R. Osborn. Pp. 285. (London: Victor Gollancz, Ltd., 1937.) 8*s.* 6*d.* net.

IN this comparative study—the first of its kind to be undertaken—the author emphasizes the importance of a closer study of psycho-analysis by Marxists, of Marxism by psycho-analysts and of both by the general public. He maintains that as psycho-analysis teaches us to recognize that unconscious motives are at work in us all, the curriculum of the Marxist should include a study of the unconscious mind, both Freud and Marx being pioneers in revolutionary psychological discoveries.

The work contains a study of the relationship between Freudian and Marxist theories regarding primitive society, the materialistic conception of history, religion and dialectical materialism. In conclusion, the author declares that "the Marxist without knowing something of the subjective side of man's life will remain one-sided, as will the Freudian who misconceives the objective situation in which man's subjective life expresses itself".

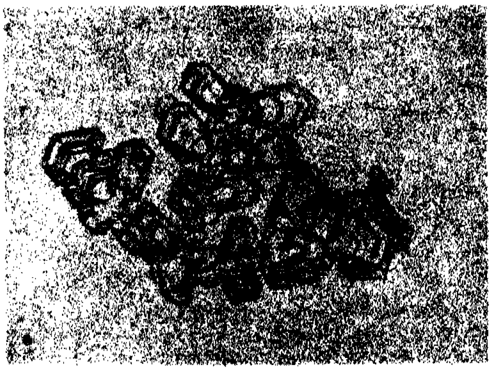
Physical Investigations on Falling Snow*

[In this article I have used the nomenclature with which I have endeavoured to standardize the English names of the various snow forms. Prof. U. Nakaya, who had not seen my work when preparing his papers, has now agreed to follow this, except that he proposes to continue to call a particle of falling snow a "snow crystal" in preference to my "snowflake". As all snow, whether falling or having lain on the ground for months, is crystalline, the word "snow crystal" is likely to lead to ambiguity. I admit that "snowflake" ("simple" for a single crystal; "compound" for an assemblage) is not perfect, but until a better word is devised it must, I fear, remain.—G. S.]

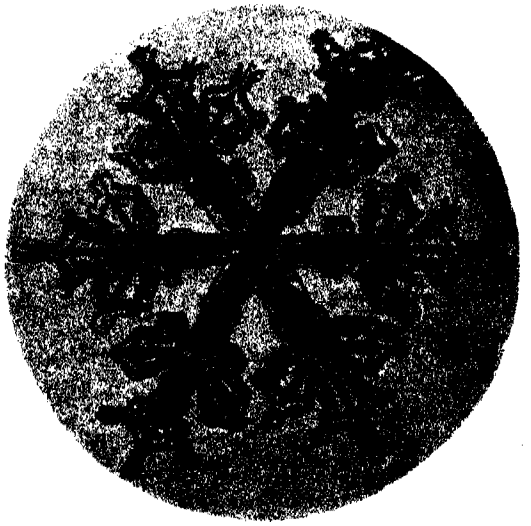
THE researches which form the subject of this article were carried out by Nakaya and his assistants at Sapporo and Mt. Tokati in the island of Hokkaido, the most northerly member of the Japanese archipelago. Ukitirô Nakaya, who is professor of physics at the Hokkaido Imperial University, has been studying the general subject for many years, but the special work of which the results are now given was done during the winters of 1933–35.

Nakaya commences his researches with a preliminary examination of the problem of snowflake structure in an attempt to find a method of classification for the many varying types, and of ascribing to each the conditions favouring its development. He wonders at the marvellously symmetrical form of the dendritic branches of a flake. "There is apparently no reason for a twig . . . to grow from one main branch when a corresponding twig happens to extend from another main branch. . . . We must suppose the existence of some means which informs other branches of the occurrence of a twig on a point of one branch." He suggests, but with doubt, the possibility of a bud of the twig causing a distortion of the lattice, which is transmitted to the other branches.

It seems simpler, however, to believe that, as I have suggested elsewhere, "changes in the scheme of ornamentation are caused by the flake passing through different temperature and concentration gradients"[1], and clearly each portion of the flake would normally come under these changes at the same instant and so symmetrical growth would be promoted.



(*a*) FROST CRYSTALS (photograph by Mr. Hatakeyama).



(*b*) CORRESPONDING SNOWFLAKE (photograph by U. Nakaya). MAGNIFICATION, 21.

Fig. 1.

One of the most important features of Nakaya's work was the designing of an apparatus for making hoar and rime under controlled conditions of temperature and humidity. Both these forms, incidentally, are crystalline, and I must respectfully join issue with Prof. Nakaya in his statement that rime, which consists of frozen water droplets, is amorphous. Previous to this he had shown that hoar crystals (which result from the sublimation of water vapour upon fixed objects as opposed to the moving nuclei of snowflakes) correspond in form with the flakes. In other words, we get needle, plate and dendritic forms of hoar just as we do of the snowflake (see Fig. 1). Arguing by analogy, he assumes the following facts for snow : that at the highest supersaturation the needle type develops, next the dendritic, then an 'intermediate' form, then the plate, the pyramidal, the prism, in that order, and, at the lowest supersaturation, prisms with one side extended in a plane. Nakaya notes that this rare type of snowflake, although occasionally seen at Sapporo, has apparently never been recorded elsewhere.

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* Based on a series of eight papers by Prof. U. Nakaya and his assistants, published in the *Journal of the Faculty of Science*, Hokkaido Imperial University, under the following titles:

(1) "Snow Crystals observed in 1933 at Sapporo and some Relations with Meteorological Conditions" (ii, 1, No. 5, Feb. 1934).

(2) "Classification and Explanation of Snow Crystals observed in the Winter of 1933–34 at Mt. Tokati and at Sapporo (ii, 1, No. 6, Dec. 1934).

(3) "On the Electrical Nature of Snow Particles" (ii, 1, No. 6, Dec. 1934).

(4) "Simultaneous Observations of the Mass, Falling Velocity and Form of Individual Snow Crystals" (ii, 1, No. 7, Oct. 1935).

(5) "On the Correspondence of Snow and Rime Crystals" (ii, 1, No. 7, Oct. 1935).

(6) "On the Artificial Production of Frost Crystals, with reference to the Mechanism of Formation of Snow Crystals" (ii, 1, No. 7, Oct. 1935).

(7) "Notes on Irregular Snow Crystals and Snow Pellets" (ii, 1, No. 8, April 1936).

(8) "General Classification of Snow Crystals and their Frequency of Occurrence" (ii, 1, No. 9, Dec. 1936).

The most surprising result is that the needle and prism appear to occupy different ends of the scale, indicating not merely different conditions of formation but perhaps even a basic difference in type. This is, I think, quite contrary to general belief, and further proof will no doubt be forthcoming. Two different types of needle are described—a single elongated form, and a bundle of thin pillars. The latter, Nakaya believes, indicates the advent of warmer conditions.

Full justice cannot be done to this line of research in the confines of a brief account, but its results, if substantiated, ought to prove of great meteorological value. Nakaya realizes this in the following words : "The delicate form and design of a snow crystal must form by developing step by step while it is falling through the various strata of the atmosphere, and the authors consider that the structure of the atmospheric layers may be inferred to some extent by investigating in parallel the structure of snowflakes." With this I cordially agree ; before having the advantage of seeing Nakaya's work, I had written, "An elaboration [of the conditions under which snowflakes grow] might prove of the greatest value to meteorology"[3], although, as Nakaya says elsewhere, no simple relationship has yet been found ; nor do I think that the problem can be solved until captive balloon ascents for the investigation of the upper air can be systematically made.

Nakaya's views on the subject of irregular or malformed snowflakes are most stimulating. Although stressing the exquisite symmetry of ordinary snowflakes, he points out that absolute and complete symmetry is never in fact attained, and that complete malformations are far more common than previous writers, Bentley for example, have led us to believe. Nakaya describes, *inter alia*, flakes deformed by the subsequent attachment of a second nucleus on which further growth takes place. Other deformations are, he says, due to the supply of water vapour from a 'one-sided direction', due, I imagine, to the flake falling irregularly. These irregular crystals are observed to fall in great frequency for a few minutes and then cease entirely. From this Nakaya has been led to think that these irregularities are not merely chance occurrences, but are caused by definite and, ultimately perhaps, ascertainable causes. I suggest that another factor may be responsible for the malformation of snowflakes. Dewar showed that electrical stimuli have a strong accelerating influence on the sublimation of water vapour. Is it not possible that these in some way, as, for example, by the sudden advent of a new electrical charge, might cause irregular growth ?

Nakaya also states that "a snowfall usually consisted of several types of snow and sometimes almost all types of flake were found in a single snowfall. Occasionally only dendritic plane flakes were observed at a given moment. These would continue for a short time, and then another type would begin to mix with them ; after some time, a third type would take its place, and so on". A graphic table shows these happenings in detail. The investigator everywhere emphasizes that his results are those found in Hokkaido only. I have, however, on many occasions observed this sequence of types in the Alps.

Nakaya commences the paper which deals with the classification of snowflakes, and which gives the impression of being the *raison d'être* of these researches, with notes on previous classifications such as those of Nordenskiöld, Hellmann and Pernter, which divided the flakes into plates, columns and their combinations. Humphreys added triangular plates and twelve-sided plates. "These classifications," Nakaya writes, "are inclined to attach too much importance to the regular crystals or the simpler form. The feature of the present classification is that we regard all the flake types as of equal importance, such as irregular [plane] crystals and those consisting of a spatial assemblage of plane branches, both of which *are, as a matter of fact, no less frequently observed among the natural snow crystals.*" This last point, which I have italicized, is stressed throughout Nakaya's work.

THE GENERAL CLASSIFICATION OF SNOW CRYSTALS

(In this case Nakaya's nomenclature has remained unaltered. *Graupel* is, of course, our soft hail.)

I. Needle crystal.
  (1) Simple needle.
  (2) Combination of needles.

II. Columnar crystal.
  (1) Simple column.
    (*a*) Pyramid.
    (*b*) Bullet type.
    (*c*) Hexagonal column.
  (2) Combination of columns.
    (*a*) Combination of bullet crystals.
    (*b*) Assemblage of short columns.

III. Plane crystal.
  (1) Regular crystals developed in one plane.
    (*a*) Stellar form.
    (*b*) Plane dendritic form.
    (*c*) Crystal of areal extensions.
    (*d*) Plate.
    (*e*) Plate with extensions at corners.
    (*f*) Stellar crystal with plates at the ends of branches.
  (2) Crystal developed from two nuclei.
  (3) Malformed crystal.
  (4) Spatial assemblage of plane branches, with a stellar base.
  (5) Spatial assemblage of plane branches, radiating type.
IV. Combination of column and plane crystals.
  (1) Column with plane crystals.
  (2) Twelve-sided crystal.
  (3) Combination of bullets with plane crystals.
V. Columnar crystal with extended side planes.
VI. Crystal with cloud particles and *Graupel*.
  (1) Crystal with droplets.
  (2) Thick plate.
  (3) *Graupel*-like snow.
  (4) *Graupel*.
VII. Amorphous snow particle.

What Nakaya terms a "bullet" is very much like the cup crystals so often found in hoar deposits, but never hitherto recorded in falling snow[3]. I also suggest that the "amorphous snow" consists, in reality, of wind-comminuted snow particles. Nakaya is able to confirm the belief that columnar crystals fall when the upper air temperature is low, but states, as I have always maintained, that temperatures at the surface have little or no bearing on this.

This classification—or perhaps it should be called grouping—will probably in time give place to one based on more essential crystallographic factors, and even, perhaps, on varying internal structures of the ice, but it certainly goes further, and gives us a far better idea of the problem, than any that have preceded it.

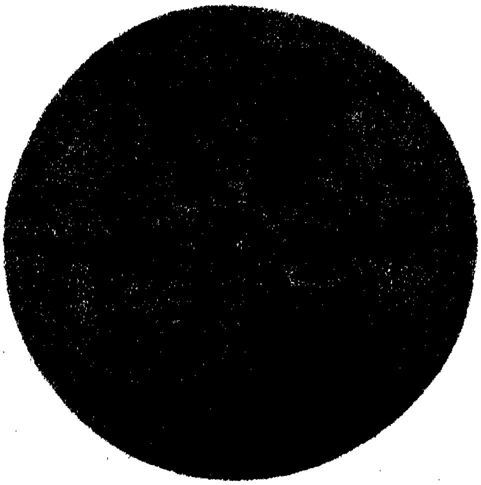

Fig. 2.

PLANE DENDRITIC SNOWFLAKE. MAGNIFICATION, 27·5.

Among what might be called the by-products of the researches the following point is of special interest, namely, that the mean thickness of a large number of dendritic flakes measured is 0·011±0·0015 mm. and is remarkably constant, the smallest being 0·009 mm. and the largest 0·015, although the diameters of the flakes measured varied from 2·35 mm. to 5·0 mm.

On the subject of the formation of soft hail, Nakaya found that it has a very low density, and therefore possesses large interstitial air spaces. He repeats the fairly well-known fact that all degrees of development of soft hail can be found, from snowflakes decked with a few frozen cloud-droplets to assemblages of ice pearls entirely hiding the flake. The satisfactory theory of the development of conical soft hail units put forth by Prof. Köhler[4] had probably not been seen by Prof. Nakaya.

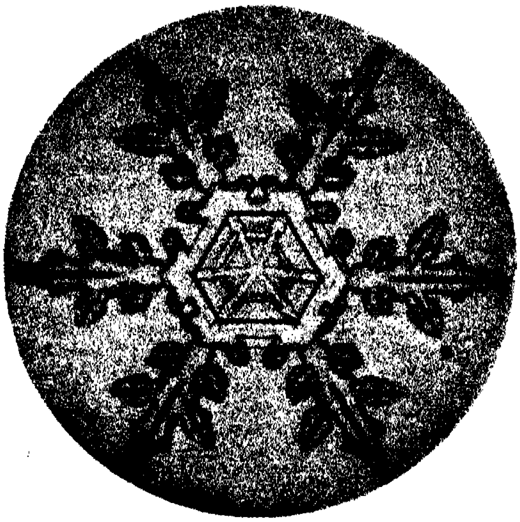

Fig. 3.

HEXAGONAL PLATE WITH DENDRITIC EXTENSIONS. MAGNIFICATION, 36·2.

Some space is devoted to the sizes of snowflakes. I believe, however, that conditions often favour continued growth during travel over a very long vertical distance, so that size is largely dependent on length of travel and is thus fortuitous. Nevertheless, the notes on the relative sizes of the various types are interesting.

Dealing with the electrical nature of snow, Nakaya found that "the number of the negative particles in general far exceeded that of the positive, being 63% of the total 1474 particles observed". When (frozen) water droplets were attached to the particles, the charge was predominantly positive.

Referring to the subject of the fall of individual flakes in relation to their mass and shape, a series of averages is tabulated as follows:

	Diameter (mm.)	Mass (mgm.)	Velocity (cm./sec.)	Ratio of velocity to that of corresponding raindrop[5]
Needle	1·53	0·004	50	1/2
Plane dendritic	3·26	0·043	31	1/6
Spatial dendritic	4·15	0·146	57	1/5
Sundry small flakes	2·15	0·064	50	1/4
Flake with droplets	2·45	0·176	100	1/5
Soft hail	2·13	0·80	180	1/2·5

Each of the eight papers is illustrated with carefully captioned photomicrographs, from which those in this article have been reproduced. Nakaya's technique of photographing snowflakes is exquisite and far superior to any that I have seen. While following the general method employed by W. A. Bentley, he gains both in accuracy and, incidentally, in artistic effect by not trimming the margins of the flakes, and by reproducing the photographs on a light instead of a dark background. Remarkable and beautiful as was Bentley's work[6], its re-publication has lost in scientific value by the omission of the degree of magnification and of meteorological conditions obtaining at the time of the collection of the flakes. Nakaya's work is a continuation of and improvement on Bentley's.

What we must now hope is that Prof. Nakaya will continue his researches. Some of his results are only tentative, and some of his later work admittedly negatives his earlier, so that a summarized version of the results of the whole eight papers in the light of his most recent experiments would add greatly to their value. Be all that as it may, there is no doubt that the work in total adds very considerably to our knowledge of the nature of falling snow.

G. SELIGMAN.

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[1] "Snow Structure and Ski Fields", p. 36 (Macmillan, 1936).

[2] *ibid.*, p. 40.

[3] Nakaya has since written that this form is a modification of the hollow cup crystal.

[4] Studien über die Nebelfrostablagerungen auf dem Partetjakko. "Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch-Lappland", **2**, Abt. 1, Meteorologie und Geophysik, Lief. 1, 1-76. (Stockholm, 1923.)

[5] According to Schmidt, W., *Sitz. Ber. Wien*, **118**, 71 (1909).

[6] "Snow Crystals", by W. A. Bentley and W. J. Humphreys (McGraw-Hill Book Co., Inc., New York, 1931).

Mendel, Morgan and Genetics

By Prof. E. W. MacBride, F.R.S.

THE modern science of genetics has acquired an enormous extension. As Prof. McDougall has said, it has swept over North America like a whirlwind. Everywhere chairs in genetics have been established, nay more, in some places special chairs in 'Drosophily' devoted to the exclusive study of this type-animal. Its votaries claim that in this science are to be found the solution not only of all the questions of the origin, propagation and improvement of our domesticated animals and cultivated plants, but also of the origin of species and evolution. Nevertheless, as time went on, the fair prospects of the science darkened. The hope of getting an unlimited number of new and valuable varieties was disappointed. As one of the professors of this science has ruefully expressed it, "The qualities that mendelize are not those which are of any value to farmers and those which farmers value do not mendelize." Anyone who reads, as I do, the minutes of the Agricultural Research Council, which contain an account of all the agricultural experiments seeking Government aid which are being carried out in Great Britain, must be struck with the fact that Mendelism is scarcely ever mentioned.

If 'genetics' be defined as the study of heredity free from presuppositions, then this study will be readily acknowledged to be a most important branch of the science of biology. But in practice, 'genetics' means the interpretation of hereditary phenomena according to fixed rules or postulates which were worked out by the late Dr. W. Bateson in Great Britain and by Prof. T. H. Morgan in the United States.

The discovery by Mendel of the facts of alternative inheritance and their rediscovery by Bateson and Correns were hailed as the greatest advance in biology since the publication of "The Origin of Species". The first question to be asked is whether what Bateson called 'unit-factors' and which are more frequently termed 'genes' have really the significance which has been attached to them. Mendel himself did not suppose that the phenomena of alternative inheritance covered more than a small part of heredity, but the persistent effort of all subsequent geneticists has been to crush all cases of heredity into this mould.

Bateson, who had the advantage of a broad education in biology at a time when in fame and brilliance the Cambridge School was at its zenith, really did most, especially in his later years, to clarify the position. He showed that alternative characters or 'allelomorphs', as he termed them, were related to each other in such a way that the dominant was characterized by something which was absent in the recessive. This definition was afterwards altered to stronger and weaker expressions of the same character. The classical experiments on peas will illustrate this point clearly. Yellow peas are dominant to green peas. But all peas when immature are green; the yellow pea on ripening transforms its chlorophyll into etiolin whereas the green pea stops short in its development. Similarly, round peas are dominant over wrinkled peas. Again, all young peas are round: in dominants, the round form is retained owing to the transformation of an adequate amount of sugar into starch, but in the wrinkled peas less starch is found and an amount of sugary solution remains, and when this dries up in ripening, a shrinkage occurs which leads to a wrinkled seed-coat. When, therefore, two parents mate and each has some of the specific characters in their dominant form, this merely means that some of the specific characters are more strongly marked in the mother and some in the father. It is sometimes possible to mate two forms such as a regular sea-urchin and a heart-urchin which have been distinct for millions of years, and in the offspring the paternal influence may sometimes show and at other times the maternal. In picking out a recessive as a new variety to be propagated, we are really selecting a weakened form. As he grew older, Bateson became more and more convinced that an increasing number of cases of inheritance could not be brought under the Mendelian laws at all.

But the great extension which 'genetics' has attained in recent years is undoubtedly due to Morgan. He has, with a certain amount of justice, been termed the founder of the science of genetics. As is well known, in the ripening of the nuclei of the sexual cells a stage occurs which is known as 'meiosis'. In this stage, the paternal and maternal chromosomes approach each other in pairs and appear to come into actual contact with one another; they then separate, and half go to one pole of the nucleus and half to another. The nucleus then divides and the number of chromosomes is thus reduced to one half: the sexual cell is now ready to unite with another one with a similarly reduced number of chromosomes and so in the zygote the full number is restored. Now, according to Morgan, when meiosis takes place, the pairing chromosomes are very long and spirally twisted, and Morgan assumes that they break and exchange portions of their substance. If, then, the Mendelizing factors are based on discrete material particles situated in definite positions in the chromosome, the transference of dominant characters from one partner to another could be accounted for. Further, if two factors were situated near each other in the chromosome, it might be expected that the break would occur in such a manner that the separated piece would contain both factors. In this way, the association of two factors in inheritance was explained. The farther apart the position of the factors in the chromosome the more seldom would they be included in the same broken-off piece, and by the relative frequency of their association enthusiasts have attempted to construct a map of the chromosome and even to reckon the distance of two factors (in 'centimorgans') from each other.

It may appear to some readers that this whole theory is a rather risky castle of cards to erect on the basis of certain very dubious assumptions; and it is one of the main purposes of this article to show that these assumptions are incorrect, and consequently the whole chromosome theory falls to the ground. The question which we wish to put is whether the appearances of two long chromosomes slightly curved around one another are really an expression of meiosis or not. In my opinion, this question has been definitely decided in the negative by two researches, namely, "The Spermatogenesis of *Lepidosiren paradoxa*" (*Quart. J. Micro. Sci.*, 57, 1911) by Dr. W. E. Agar of Glasgow (now professor of zoology in the University of Melbourne) and "The Meiotic Phase in Vertebrates" by Prof. C. E. Walker of the Department of Cytology in the University of Liverpool. The latter research was published in two papers, namely, "The Meiotic Phase in *Triton vulgaris*" (*Proc. Roy. Soc.*, B, 98; 1925) and "The Meiotic Phase in Certain Mammals" (*Proc. Roy. Soc.* B, 99; 1926).

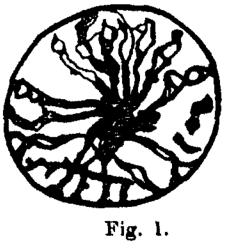
Fig. 1.
THE 'FIRST' MEIOSIS OF *LEPIDOSIREN*

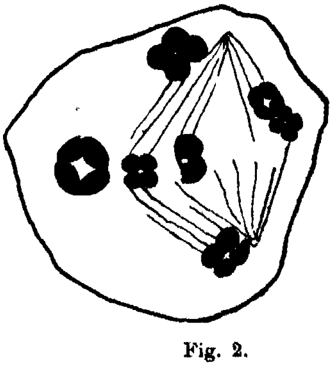
Fig. 2.
THE 'SECOND' MEIOSIS OF *LEPIDOSIREN*

Agar's researches were suggested to him by his teacher, Prof. Graham Kerr. This was a stroke of genius on Prof. Kerr's part. He argued thus: if so much importance is attached to minute details in the ripening process of the nucleus, would it not be essential to study them in the largest nuclei available? He knew well that the nuclei of the sexual cells of the testes in *Lepidosiren* were gigantic, so large indeed that it is impossible to include one of them as a single microtome section.

Agar found the ripening process beginning with the apparent apposition of two long chromosomes in the manner described by Morgan, and as he was at the time an orthodox geneticist, he interpreted it in the same manner. But to his amazement, when the putative meiotic partners separated, they shortened and condensed and the same partners then underwent *a second meiosis* during the ripening of the same nucleus! The so-called first meiosis as described by Agar is shown in

Fig. 1; the second in Fig. 2. In the 'second' meiosis it can be seen that the chromosomes are reduced to short rounded nodules, and any supposition that they could break and exchange pieces of substance is obviously ludicrous.

But Agar's supposition that the same two partners could undergo meiotic pairing twice in the same ripening cycle is clearly incredible, and the account given by Dr. Walker unravels the mystery. By his researches, which were begun on the newt in his first paper and continued on several mammals in his second paper, he has proved conclusively that Agar's 'first meiosis' is not a meiosis at all but a belated ordinary division of the nucleus. This begins in the telophase of the preceding division of the sexual cell. When this division is complete and the daughter nuclei are passing into the resting phase, the telophase filaments can be seen to be split. In the resting phase this split disappears. But in the subsequent stage of activity, when long thin threads begin to be differentiated (the so-called leptotene stage), the split reappears and the separating chromosomes have been mistaken for meiotic partners. The pictures drawn by enthusiastic geneticists of long chromosomes with nodular thickenings opposite each other as proofs that similar 'genes' attract one another, are simply the expression of the division of moniliform chromosomes.

If, then, it is impossible to talk of 'genes' being in any particular chromosome—or of breaking and crossing over—it is difficult to see what remains of modern 'genetics'. As readers of NATURE are well aware, I am convinced that functional heredity, in other words, the handing on in some degree of habits acquired in one generation to the next, has been finally proved to be true, and this principle once admitted is sufficient to explain evolution and the origin of natural races and species. But the question of the origin, nature and inheritance of mutations, otherwise 'sports', remains to be dealt with. On this subject a great deal of light has been thrown by Prof. Mohr, of the University of Oslo, in a paper entitled "Über Letalfaktoren mit Berüksichtigung ihres Verhaltens bei Haustieren und beim Menschen" (*Zeitschrift für induktive Abstammungsund Vererbungslehre*, 41; 1926). He shows that in *Drosophila* and in other forms an astounding number of mutations are what he terms 'lethal' or 'sub-lethal'. In *Drosophila*, the so-called 'modifying' factors which by themselves produce no outward visible effect and indeed whose existence is assumed in order to force the facts into the Morgan scheme, produce no effect on the viability of the insect. These he places in fanciful comparison at the red end of the spectrum. As we pass towards the yellow and green we encounter mutations which make a marked difference in the appearance of the insect, and these decrease the viability until in the blue we encounter the sublethal mutations which injure their carriers so much that they can only be reared in a cross with a normal form. We finally reach the lethal factors in the violet, which even in a cross cause the death of their carriers. He shows further that such mutations are distributed over all the chromosomes and that new lethal factors are continually coming into being.

The obvious conclusion is that all mutations are of the physiological nature of damage to the growing powers of the germ, and when we consider the known artificial means of producing mutations, such as X-rays, heat, etc., applied to the eggs, this conclusion is so clear as scarcely to require statement. These agents kill the majority of eggs subjected to their influence: some resist them unaltered and some are half-killed and grow up to produce the mutations. Beneficent mutations which could survive in the struggle for existence are figments of the imagination.

Johannsen's demonstration that in a 'pure line' fluctuating variations are non-heritable marks one of the great advances in evolutionary knowledge, for it destroyed the basal assumption of the classical Darwinian theory that heritable variations in all directions are constantly occurring, some of which may *chance* to fit the environment and so be preserved. It was he who invented the term 'gene' as the cause of a mutation. About this word he says ("Some Remarks about Heredity," *Hereditas*, 4, 1923): "I introduced the word 'gene' when I was possessed by the antiquated spirit shown in Galton's, Weismann's and Mendel's viewpoints. Here we shall try to exterminate in genetics the term 'unit-character' because it indicates a notion inadequate and noxious for genetics. The most important part of the genotype does not seem able to segregate into units; as yet we are operating with characters which are superficial in comparison with the fundamental specific organic nature of the organism. However we try to analyse a genotype into factors we must remember that the characters of the organism, that is, its phenotypical features, are the reaction of the genotype *in toto*. Mendelian units *per se* are powerless. Are the experimentally demonstrated units anything more than expressions for local deviations from the original normal state of the chromosomes? *The Weismannian distinction between germ-plasm and soma, that is, absolute independence, does not exist in reality.* 'Gene' has nothing to do with De Vries's expression 'Pangenes' and their behaviour as units; the phenotype is the reaction of the genotype (nature) with the ambient conditions (nurture)."

Obituary Notice

Prof. Hans Reck

PROF. HANS RECK, professor in the Institute of Geology and Palæontology of the Friedrich-Wilhelm University, Berlin, died suddenly of heart-failure at Lourenço Marquez on August 4, at the age of fifty-one years. He was on his way from Natal to Lake Eyassi, Tanganyika Territory, to examine the locality where Dr. Kohl-Larsen discovered a human skull in 1935 (NATURE, 138, 1082; 1936).

Hans Reck was born in Würzburg on January 24, 1886. He studied geology at the Universities of Berlin, of Munich, where he graduated as Ph.D. in 1910, and of London, at University College. During his undergraduate years he visited Iceland in company with his future wife, Frl. Ina von Grumbkow, who survives him. In 1912 he was appointed leader of the Tendaguru Expedition of the University of Berlin; in 1913, leader of the Geological Expedition to Central Africa sponsored by the Royal Prussian Academy; at the end of 1913, leader of the Olduvai Expedition of the Universities of Berlin and Munich; and during the years 1915–19 he held the post of Government geologist in German East Africa.

After the Great War, Reck had not the same opportunities for work in the foreign field. Nevertheless, he twice visited Santorin, in 1925 and 1929. He was a member of the second Olduvai Expedition, in 1931, under the leadership of Dr. L. S. B. Leakey, and in 1932 visited South Africa to collect fossil reptiles. He left Germany at the end of September 1936 to carry out researches in the Cameroons, South Africa, Tanganyika and Kenya Colony; this trip was interrupted by his untimely death.

Reck's work on the geology of East Africa is inadequately represented by a number of scattered papers. As editor and part author of the "Wissenschaftliche Ergebnisse der Oldoway-Expedition, 1913", he had the satisfaction of seeing the palæontological results published in full; but the difficulty of raising funds caused many delays, and his account of the geology, which was to appear at a later date, was left unfinished. Nor did he issue any technical description of the giant caldron volcanoes, every one of which he had climbed. Nevertheless, he was a great pioneer in this field, and his influence on post-War research cannot easily be estimated.

Most of Reck's published work relates to volcanoes, on which he was a leading authority. He appears as a *Mitarbeiter* in the first part of the *Zeitschrift für Vulkanologie* (1911), and as joint editor in 1923. In addition to many papers and numerous reviews contributed to the *Zeitschrift*, he published in 1923 "Die Hegan Vulkane" and "Physiographische Studien über vulkanischen Bomben". An exhaustive monograph on Santorin, completed just before he began his last journey, is in the press.

Tall, fair, and blue-eyed, Reck was a Bavarian of the finest type. His sunny disposition and upright character endeared him to all who had the privilege of his friendship. Himself incapable of an ungenerous thought or act, he was unable to understand them in others. In addition to his scientific pursuits, he found time to form a small but choice collection of Arab art, to become a gifted pianist, and to cultivate the delightful literary style which appears in "Oldoway, die Schlucht des Urmenschen", and in "Buschteufel", a volume of light-hearted stories of the campaign in East Africa and of life as a prisoner of war in Egypt.

A. TINDELL HOPWOOD.

News and Views

Mr. C. C. Paterson, O.B.E.

MR. CLIFFORD C. PATERSON, director of the Research Laboratories of the General Electric Co. Ltd., has had the honorary degree of doctor of science conferred on him by the University of Birmingham "in recognition of his many contributions and services to electrical science". Dr. Paterson, who is now fifty-seven years of age, was for sixteen years a member of the staff of the National Physical Laboratory, where he established and administered the Electrotechnics and Photometry Divisions of the Laboratory until 1918. He then accepted the task under Lord Hirst of initiating the G.E.C. Laboratories at Wembley. These have now grown so much in size and influence that they have a personnel of 500 and cover a floor area of about 170,000 sq. ft. Dr. Paterson's activities have not been confined to the Wembley Laboratories. He was president of the Institution of Electrical Engineers in the year of the Faraday celebrations (1931). He has been president of the International Illumination Commission, the Illuminating Engineering Society, and this year of the Institute of Physics; he is also a vice-president of the Royal Institution and of the Royal Society of Arts. He has been Faraday lecturer of the Institution of Electrical Engineers, Huxley lecturer of the University of Birmingham, and is this year Guthrie lecturer of the Physical Society. Whilst Dr. Paterson's activities in engineering and science have covered a wide range, his chief personal contributions and scientific papers have been in the fields of light and lighting.

Palæolithic Man in Brittany

IN view of recent reference to the fact that evidence of a Palæolithic Age had not been found in Brittany (see NATURE, Aug. 21, p. 329), it is of interest to note that M. R. Mazères records in the current number of *L'Anthropologie* (47, 3–4) that he has found a number of flint implements of that period, when examining the quaternary deposits of the cliffs in the bay of St. Brieuc (Côte-du-Nord). The deposits include a lower and upper loess. Of these the lower, a gray loess attributed to the Riss glaciation, is ravined by interglacial deposits of marine origin, with an abundance of *Buccinum reticulatum*, and evidence of a superimposed raised beach at an altitude 8–9 metres, which would warrant an attribution to Mousterian, or Tyrrhenian II. Above this, and at times associated with traces of the raised beach, is the upper loess, showing evidence of two periods of deposition. In the earlier deposits of this phase were found a dozen flint implements of Mousterian facies, with flakes of diabase and other stone of the same technique in working, and the tooth of a reindeer. The use of stone other than flint is attributed to the scarcity of the latter material in the neighbourhood. The later deposits yielded two well-made carinated scrapers of flint of Middle Aurignacian type. In the same horizon, but at another site, were found a reindeer tooth and the tooth of one of the Bovidæ. The attribution of the upper loess to Würm I and Würm II is thus confirmed by the character of the contained implements. M. Mazères points out that, modest as these finds are, they serve to indicate the existence of a palæolithic culture in Brittany. This is now apparently recorded for the first time; but M. Mazères recalls that in 1926 Prof. Milon and the Abbé Leclerc found a mammoth tusk in the loess to the north of Pléneuf, near the location of the present finds, and with it were flints which have not been studied.

Recent Archæological Excavations in Great Britain

THE continued examination of the neolithic barrow at Chilham, Kent, known as Julaber's Grave, which is in course of excavation by Mr. R. F. Jessup on behalf of the owner, Sir Edmund Davis (see NATURE, August 7, p. 228), has brought to light further evidence regarded as confirming local tradition. The occurrence, among other finds, of equine bones and teeth (*The Times*, August 16) seems to afford some foundation for the belief that the remains of one hundred horses and one hundred men were buried in the barrow. An examination of the teeth, however, suggests that the horses may have been buried there at various times in a period of centuries. Excavation has ceased for this season, but will be resumed in July next. A five weeks' season of excavation at Milber Camp, Newton Abbot, conducted by the Devon Archæological Society under the direction of Mr. F. C. Cottrill, leads to the conclusion that the camp was constructed in the last century before the Roman invasion for the purpose, it would appear, of commanding the junction of two important tracks, and that it was abandoned when the Romans built a bridge over the river at Teignmouth. Among the finds brought to light in the course of the excavation were a polished stone axe, a sling stone, decorated spindle whorls and pottery. The site was reoccupied in the Middle Ages, probably by shepherds.

Two food vessels, attributed to a date of about 2000 B.C., are reported to have been unearthed by workmen employed in the Fife Redstone Quarry, Belmullo, near St. Andrews. They were found at a depth of three feet below the surface on the side of a hill. They stand about six inches high, have a diameter of about four inches, and are ornamented with a decoration of cord impressions. Operations at the Meare Lake Village, near Glastonbury, in Somerset, were resumed for the current season on August 23. Dr. A. Bulleid and Mr. H. St. George Gray are again in charge of the excavations, acting on behalf of the Somerset Archæological and Natural History Society. The work of investigation this year will be confined to the central portion of the main group of dwellings of the East Village, upon which operations have been concentrated for the last four years. Until four years ago the West Village had been the principal site of excavation. A monograph has been prepared and is about to be published on the results obtained in the period between 1910, when the systematic examination of this site began after the close of investigations at the Lake Village of Glastonbury, and 1933, when excavation on the West Village was brought to an end. About half this part of the site had then been investigated. The excavations this year will be carried on for a period of four weeks.

Excavations on the Roman Site at Wroxeter

THE Committee of the Wroxeter Excavation Fund has issued an appeal for funds to enable it to continue excavation on the Roman site of Uriconium. Previous investigations have covered about ten acres of a total area of 200 acres. Excavations were undertaken last year on a small scale by the Shropshire Archæological Society. It is proposed to continue these excavations. Generous assistance has been given by Sir Charles Marston, who is president of the Shropshire Archæological Society, and subscriptions have been promised by the Society of Antiquaries of London and All Souls' College, Oxford. The excavation again will be directed by Miss Kathleen Kenyon, who was in charge last year. The objects of this season's operations will be the further examination of the so-called Baths building by excavation on its north side, and the identification and excavation of the east gate of the city. It is anticipated that these investigations will throw light on three important problems: the history of the defences, the plan of the city, and the line of Watling Street, which is here in dispute. Donations should be addressed to the secretary of the Fund, Mr. A. E. Cooper, 28 Claremont Hill, Shrewsbury.

Industrial Research in India

THE report of the Industrial Research Bureau, Government of India, for 1936–37, covers the work of the Industrial Research Council and the research work at the Government Test House as well as the work of the Bureau (Delhi: Manager of Publications, 1937. 14 annas; 1*s.* 6*d.*) The Industrial Research Council is an advisory body, consisting of representatives and non-official nominees of the central, provincial and leading State Governments, which meets once a year to discuss policy in the co-ordination and development of research. Programmes for road research have been approved by the Council, and the development of the manufacture of casein plastics has been considered both by the Council and by the Bureau. Industrial standardization and the compilation of a list of researches in progress or contemplated in industrial laboratories are also receiving attention, and a number of prizes have been awarded by the Council for papers bearing on industrial development. The research branch of the Government Test House which deals with the research programmes suggested by the Council and other problems referred to the Bureau has completed a preliminary investigation on the characteristics which affect the setting of red lead paint. For accelerated weathering tests on various paints the weatherometer, modified to give test conditions approximately to outside weather conditions at Alipore, has been used.

SPECIAL apparatus has also been developed in India for accelerated life tests on dry cells and considerable attention has been devoted to the use of vegetable oils for internal combustion engines. A process has been developed for rendering castor oil miscible with mineral oils of known suitability for use in such engines, and the effects of various anti-oxidants have been investigated. Steady progress has been made with the work of modifying the Morris and Lister engines and of equipping them with accessories to render the operating conditions fully controllable. Another section has been responsible for important investigations on the properties of petrol-benzole mixtures and the effect of changes in the composition of the benzole. A number of investigations on sand, lime, surkhi, clay, etc., have been initiated. Good progress has been made with the design of the equipment for the proposed road test track at Calcutta. Separate chapters in the report deal with work on glass and on oils and soaps, the former including the improvement of glass furnaces and a survey of glass-making materials.

Research in the Iron and Steel Industry

AT the request of the Board of Trade, the Import Duties Advisory Committee has conducted an inquiry into "The Present Position and Future Development of the Iron and Steel Industry", and its report, which is full of interest, has now been issued (Cmd. 5507. London: H.M. Stationery Office, 1937. 2*s.* net). The report is essentially concerned with economic conditions, but its authors recognize that both the present and the future of the industry are closely bound up with scientific control and research. They express their satisfaction with the provision made for research and their hope that it will be further extended in the future. The total industrial subscription to the Iron and Steel Industrial Research Council for 1936–37 is estimated as £30,000. As the capital of the concerns estimated to be responsible for 86 per cent of the country's output of steel in 1936 is given as £126·7 millions, this cannot be considered an excessive allowance. Several of the large steel concerns have their own research laboratories, involving a considerable expenditure, and these have actively collaborated in the investigations of the Council, thus making an indirect contribution. Full particulars of the research organization were furnished to the Committee by the Department of Scientific and Industrial Research in writing, but the seventy-three witnesses examined orally did not include a scientific metallurgist or a director of a research laboratory, and one would have welcomed a fuller appreciation in the report of the fact that the economies to be effected by scientific improvements—as, for example, in the field of refractories—are as important as the improvements in organization to which the report, thorough as it is, is almost entirely devoted.

Far Eastern Conference on Rural Hygiene

A CONFERENCE for Far Eastern countries on this subject was opened on August 3 by the Governor-General at Bandoeng, Java. This Conference was arranged by the League of Nations Health Organisation under the presidency of Dr. T. Offringa, director of the Netherlands Indies Public Health Service, with Dr. J. Rajchman, medical director of the League Health Committee, as secretary, assisted by Dr. C. L. Park, director of the Eastern Bureau of the Health Organisation. The Conference is meeting in five sections, in which the following subjects will be discussed: (1) health and medical services: the advantages and disadvantages of training 'semi-qualified' or assistant doctors to assist the qualified medical staff, and possible alternatives; (2) rural reconstruction and collaboration of the population, with the view of improving conditions of life in rural districts, a policy favoured by the Government of India and other countries; (3) sanitation and sanitary engineering, including housing, water supply, latrines, refuse disposal and fly control; (4) nutrition, a subject of importance in the East, for it has been estimated that 75 per cent of the population of Asiatic countries exist on a diet below the standards fixed by European science; (5) measures necessary to combat specific diseases, such as malaria, plague, tuberculosis, hookworm infection, yaws and leprosy, and mental diseases; also drug addiction.

The Science Museum

BESIDES the usual statistical information regarding the number of visitors and attendances at lectures, notes on special exhibitions, on acquisitions and the progress of the five main divisions of the Museum, the annual report of the Advisory Council of the Science Museum for 1936 is of especial interest as it contains a review of the growth and activities of the Library, which is being developed as a National Library of Science. During the year, the Library was used by 22,000 readers, while the issues on loan of books and periodicals to Government departments, scientific and technical societies, colleges, etc., was 21,000. The Library receives more than 9,000 current periodicals and the contents of these are all indexed, references to these and to other matters now running into millions. There are about 250,000 books in the Library. "The two main functions of the Library," the report says, "may broadly be stated as the acquiring of documents and making them readily available", the latter consisting of cataloguing the volumes, maintaining indexes of their contents, provision of the volumes to readers, loan service, supply of bibliographies, supply of photostat copies, and Library publications. There have been many valuable additions to the collections in the Museum, and during the year under review special exhibitions were arranged illustrating the progress of research at very low temperatures, the scientific aspects of smoke pollution of the atmosphere and the developments in electric illumination.

Overhead Costs in Business Management

One of the most difficult tasks for a business management, whether the concern be large or small, is the adequate control of overhead costs. The usual classification of overhead expenses into salaries, rent, rates and taxes, legal expenses or the like is quite inadequate, because responsibilities cannot be tied up with the expenditure on these items, and generally there is no method of measuring the value obtained from the expenditure. In a valuable and thought-provoking report entitled "The Control of Overheads" (Mansfield House, 376 Strand, W.C.2. 5*s*.), prepared by a committee of the Management Research Groups, the subject is examined with the aim of securing effective control through localization of responsibility. To secure this, the report recommends the division of *all* overhead expenditure into a series of functions or services, each of which would be in charge of one person, thus permitting the fixation of responsibility. In order to assess the value of the work done by each section of the organization, its cost must be related to the volume of the work done and to the value or quality of that work; and for this purpose various ratios or 'yard sticks' are suggested in the report. The essential requirement is that responsibility for functional costs should be invested in persons, and to ensure that personnel shall cover each of the functions, it is most desirable that an organization chart should be constructed. Budgetary control is an excellent method of reviewing expenses in advance and making comparisons immediately results are available. Costs, however, may be rendered useless as a means of measuring efficiency because of plant working under capacity owing to insufficiency of orders. The report, therefore, recommends that the costs be 'purified' of the cost of idle plant by the abstracting and debiting of all such expenses to a non-productive account, which is carried straight on the trading account.

Economics of Wages and Price Levels

In an address before the Economic Reform Club, London, on June 30, entitled "The Economic Reforms Required for Lasting Prosperity and Peace" which has now been issued in pamphlet form (Economic Reform Club, 61 Great Cumberland Place, London, W.1. 9*d*.), Mr. A. G. McGregor stresses the supreme importance of reform in wages regulation in securing a steady purchasing power of the pound. He urges that the method of adjusting wages by industrial dispute should be abolished and replaced by direct government control to adjust wages in accordance with the price level. This would in the first instance involve raising wages and salaries to a level which would bring consuming power in step with productive power, and thereafter the wages board would maintain the proper relation between wages and price level. He stresses the point that bankers should be relieved of all responsibility over the general price level and outlines the functions of a rational banking policy designed to accommodate industry and commerce with the necessary funds but under rules which eliminate any monetary influence on the price level. He contends that if wages and salaries are controlled in the way indicated so as to secure a satisfactory equilibrium between consuming power and productive power, economic liberty is no more affected than individual freedom in general by the ordinary government responsibility for maintaining law and order, and also that the higher wages and internal consuming power would assist the export trade.

Purchasing Power with a Managed Gold Standard

In a pamphlet entitled "A Managed Gold Standard" (W. Heffer and Sons, Ltd., Cambridge), E. A. Meyer urges that unemployment and economic distress are due to lack of purchasing power. The State's lack of purchasing power has necessitated higher taxes, which have further decreased the citizen's purchasing power. This lack of purchasing power is due to lack of counters, or money, used for exchanging one man's labour for another's, caused by the inability of an inflexible money standard to keep pace with a continuous rise in prices. He advocates accordingly a managed gold standard based on the monopolization by the State of the note issuing bank of the standard (gold), and the fixation of the standard's money value by an international commission which should revise this value periodically according to the need of the world's productive ability to ensure the standard's flexibility. The managed standard will instantly increase the purchasing power of the State by increasing its right to issue counters without risk of devaluation, and this increased purchasing power by permitting decreased taxation will increase the purchasing power of the citizen as well as thus stimulating industrial and commercial prosperity. Unemployment will be further diminished or eliminated by the increased ability of the State to initiate public works. The managed gold standard could be introduced if a few countries only agreed to do so, since other countries would be bound to follow.

The Television Cable

IN the Engineering Supplement to the *Siemens Magazine* of June, Mr. A. Rosen describes the London television cable which joins the Alexandra Palace studio to Broadcasting House and goes thence to the Whitehall Telephone Exchange. Success is being achieved and provincial cities are looking forward to having broadcast television services. It is probable that eventually there will be a network of television cables interconnecting the studios and transmitters throughout the country, similar to the grid of the programme circuits which now exists for sound broadcasting. Television is analogous to telephony. In telephony the voice sounds are converted by the microphone into equivalent alternating currents; these are transmitted to the receiving loud-speaker, where they are converted back to the voice sounds. Similarly the visual image is converted by the television camera into equivalent electric currents which are carried to the receiver where the cathode ray tube converts them back to the visual image. In both cases the transmission between sender and receiver can be effected over a metallic circuit, or by a radio link or by a combination of the two methods.

THE chief points of difference between the two transmissions concern the band of frequencies which have to be transmitted. In telephony, for music it suffices to transmit currents of frequency lying between 50 and 10,000 cycles to get excellent results. The television camera generates a much wider band of frequencies. In the Marconi-E.M.I. system, the frequencies range from zero to more than two million cycles. This necessitates the use of a correspondingly high carrier frequency for radio television transmission. The B.B.C. is to be congratulated on its notable achievement in televising the Coronation procession. This was the first successful high-definition relay in the world. The E.M.I. and Siemens gave valuable assistance to the B.B.C. in carrying out this enterprise. The author states that for trustworthy transmission between points more than 25 miles apart cables are necessary. Radio links also are liable to be affected by 'man-made' disturbances such as the radiations produced by the ignition systems of motor cars.

The Electrification of the Rigi Railway

IT is now sixty-six years ago since the first rack railway in Europe, the Rigi railway, between Vitznau on the Lake of Lucerne and the top of the Rigi, was opened. It will be electrified in the autumn of the present year and will be brought into line with the latest modern requirements. The new motor-coaches will be light and comfortable, and the increase in speed will shorten the trip considerably. Fewer employees will be required as the preliminary work done in starting up the steam locomotives will be done away with and because it is easier to supervise electric vehicles. One-man control also suffices in the motor-coaches. When peak track conditions occur some of the existing steam locomotives can be used, and these are kept as a useful stand-by. The electric equipment of the motor-coaches will be built by Brown, Boveri and Co., Ltd., Baden, while the mechanical part and coachwork will be constructed by the Swiss Locomotive Works at Winterthur. Direct current will be used at a pressure of 1,500 volts and the average running speed will be about nine miles per hour. On the up-grade, the highest running speed is about eleven miles an hour and on the down-grade about seven miles an hour. The difference in altitude between the Vitznau and Rigi Kulm stations is about 4,300 feet, and the steepest gradient is 25 per cent. In the *Brown Boveri Review* of March, diagrams of the new coaches are shown. The braking devices comprise electric resistance braking as service brake on the down-grade and two hand brakes independent of one another and actuated by spindle from either driver cab. When the brake is applied on the up-grade it prevents the coach running backwards should the current fail. There is also an overspeed brake which operates on a brake drum on the motor and only acts on down-grade running. In emergencies it is put into action by a safety device.

The House-Rat in the United States

ALTHOUGH the black rat (*Rattus rattus*) still predominates in the southern States, particularly in Florida and the States bordering the Gulf of Mexico, throughout the States in the temperate zone it has been displaced by the brown rat (*Rattus norvegicus*), which appears to have been introduced about the beginning of the American Revolution, in 1775. Now the rat population is enormous—in Texas some years ago 153,720 rat tails were collected in six weeks; in Georgia, Alabama and Texas during the typhus fever control campaign in 1934, it was estimated that 7,500,000 rats were destroyed on 747,608 premises treated, or approximately two rats for every person living on the premises. The total economic damage done by these pests is enormous. In the course of one of its inquiries, the Biological Survey received 14,650 replies from farmers co-operating in rat campaigns, and the annual losses therein reported averaged 35 dollars a farm, while a computation of the grand total of loss throughout the United States each year is 189 million dollars. In addition, rats are seriously concerned in the conveyance of certain diseases among human beings and domestic stock, and in an effort to arouse co-operative measures of rat-control, the U.S. Department of Agriculture has published an eighteen-page circular (No. 423, Jan. 1937) on "The House Rat".

Migrations of Salmon

AT a meeting of the Washington Academy of Sciences held recently, a discussion on the homing migrations of salmon was opened by Prof. Henry B. Ward. According to a report by Science Service, of Washington, D.C., he said that the return of salmon, generation after generation, to their ancestral breeding grounds, is a response to definite stimuli, amongst which he regards temperature as being the most powerful. Swiftness of current has also some effect in guiding the fishes, although relative acidity of the water seems to have no influence. But if it be admitted that salmon return to the streams where they were born—and there is much evidence supporting that view—it cannot be admitted that either the temperature of a particular stream or the swiftness of its current remains constant. It is difficult to understand, therefore, just how these variable factors can guide migrating salmon, not to a specially cold or swift stream, but to a particular stream the one outstanding character of which is that they were born there.

U.S. Zoological Expedition to Far East

A PARTY of scientific workers from Harvard and Johns Hopkins Universities has set out with the intention of making a survey of the birds and mammals of Siam, Borneo and Sumatra (Science Service, Washington, D.C.). The results should be of special significance, for the programme includes study of the social life of some of the most interesting of the higher monkeys. In the jungles of Siam, the habits of the gibbons will be observed for three or four months by Dr. Carpenter; other members of the expedition will carry out parallel observations in British North Borneo on orang-utans, gibbons and proboscis monkeys; while, later, in the mountains of northern Sumatra, orang-utans will be studied in the national park recently set aside by the Netherlands Government to protect this rapidly disappearing animal. It is expected that the study of the social habits of these creatures may throw light upon the problems of man's social and physical evolution.

Radio-Therapeutic Treatment of Cancer

THE Ministry of Health has issued an important publication on cancer treatment entitled "Cancer: Memorandum on Provision of Radio-Therapeutic Departments in General Hospitals", by Lieut.-Colonel Smallman (Reps. on Pub. Health and Med. Subjects, No. 79. London: H.M. Stationery Office. 9*d*. net). A principal reason for the preparation of this memorandum is the growing use of radium and X-rays in the treatment of cancer, in substitution for, or in conjunction with, surgery. As a result, hospitals in which cancer patients are treated need to be specially equipped and staffed for this part of their work. The memorandum emphasizes the importance of team work, and that the radiotherapeutic department should be in close touch not only with the surgical department, but also with other departments (gynaecological, pathological, etc.) provided by the hospital of which it should form an integral part. It concludes that a general hospital should contain some three hundred beds if it is to make reasonably full use of radiation treatment facilities. Plans are given for the lay-out of a radiotherapeutic department, the various features of which are explained in the text. The memorandum discusses how those hospitals which cannot provide full cancer treatment facilities can be enabled to make use of other hospitals in which full facilities exist. Appendixes contain the recommendations of the British X-Ray and Radium Protection Committee and of the Radium Commission on the care and custody of radium.

Physics at Harvard

THE volume of "Contributions" from the Physical Laboratories of Harvard University for 1935 is again of quarto form and consists of reprints without change of pagination, of fifty-seven memoirs by members of the staff, fellows and students which have appeared in scientific periodicals such as the *Physical Review*, the *Proceedings of the American Academy*, the *Review of Scientific Instruments*, during 1935 and the first two months of 1936. The quarto form allows the inclusion of the large double column pages of *Industrial and Engineering Chemistry*, but gives very wide margins to the single column pages of the *Proceedings* of the Academy. Work on the physical properties of materials at high hydrostatic pressure accounts for seven or eight of the memoirs, and special interest is attached to Prof. P. W. Bridgman's method of securing measurements at 50,000 atmospheres pressure in steel vessels which normally rupture at 20,000 atmospheres. Atomic physics accounts for about a dozen memoirs, of which that on the quantum theory of valence by Prof. Van Vleck and Dr. Sherman, a fellow of the National Research Council, reprinted from *Reviews of Modern Physics*, may be mentioned. The whole volume bears evidence to the active part Harvard is taking in the advance of knowledge.

Field Work of the Smithsonian Institution in 1936

THE preliminary survey of recent field work of the Smithsonian Institution ("Explorations and Field-Work of the Smithsonian Institution in 1936." Washington, D.C., 1937; pp. 100) covers nineteen investigations, beginning with Dr. G. C. Abbot's "Exploring Solar Power Possibilities" and including research in geology, palæontology, zoology, botany and anthropology, the last-named predominating with seven investigations, mostly archæological. Of these last, Dr. Hrdlička's explorations of sites on Kodiak Island, Alaska, and the Aleutian Islands have attracted no little attention, not only on account of the exceptionally large number of antiquities brought back by this year's expedition, but also by the collection of mummified human remains from Kagamil. Dr. Henry B. Collins, jun., by his excavations at Bering Strait, has succeeded in determining beyond question the place of the Thule culture in the cultural succession at this gate of entry of man into the American continent—an important contribution to the Eskimo problem—and also has arrived at the conclusion that there is little hope of discovering any trace here of the passage of early man prior to the Eskimo, owing to physiographic changes. Further investigations by Dr. Frank H. Roberts, jun., on sites of the Folsom culture in Colorado and on a new site in Iowa discovered in 1935, the easternmost occurrence noted of the true Folsom stone point, have yielded new data bearing on the occurrence of this early type of the American stone age. It is now established that Folsom man was contemporary with the extinct camel, and also that he lived before, as well as at the same time as, the thick growth of vegetation which preceded the present condition of aridity in the south-western area. This points to an antiquity even higher than that indicated by previous evidence.

Liverpool Naturalists' Field Club

THE seventy-sixth Annual Proceedings of the Liverpool Naturalists' Field Club, recently issued, covers the year 1936. The botanical notes include a summary by Mr. J. D. Massey of ninety new plant stations in the area recorded in the past four years since the compilation of Dr. Green's last "Flora of Liverpool", while Mr. W. S. Laverock, the botanical referee, describes the finding of deadly nightshade (*Atropa belladonna*) at Eastham, adder's tongue fern (*Ophioglossum vulgatum*) near the Manchester Ship Canal at Mount Manisty, young sycamore trees with variegated foliage at Irby woods, and other incidents of the field meetings of the year. The year's ornithological records, compiled by Mr. Eric Hardy, the ornithological referee, include a water-pipit, ruffs, a part-albino pied wagtail, curlew-sandpiper, little stint, greenshanks, green-sandpipers and a very late (November 28) yellow wagtail at Liverpool Sewage Farm, the latter (after a fog spell) a day later than the previous latest record in Britain; crossbills in the Ainsdale-Freshfield pinewoods in winter, a scaup wintering at the Botanic Park, Liverpool, puffins, fork-tailed petrels and mergansers in the Dee Estuary, a redwing summering in Knowsley Park and the nesting of the Canada goose and little grebe at Kirkby Dam, lesser black-backed gull and curlew at Simonswood, oyster-catcher and rock-pipit by the Ship Canal below Eastham, shoveller at Burton, grasshopper-warbler at Ince and Gayton in Wirral, and blackcap in Knowsley Park. The long-tailed duck is reported in full summer plumage feeding on crabs in West Kirby marine lake in mid-May. There are also the results of surveys carried out in the area for the British Trust for Ornithology, etc. The Committee reports an increase in membership during the year, the formation of a junior section, and an appeal for the Ornithological Fund.

Review of Agriculture

THE Royal Agricultural Society of England (16 Bedford Square, London, W.C.1) has published its ninety-seventh volume, which includes, as last year, the "Farmers' Guide to Agricultural Research". The latter consists of a review of research work in various branches of agriculture, each section being contributed by a recognised authority on the subject. The journal also contains a number of special articles on important questions such as housing the agricultural worker, labour, power and equipment in arable farming, the improvement of hill grazings and the technique of modern field experiments. On the animal side are articles dealing with the control of sheep ticks and systems of housing for pigs. The series on notable farm enterprises is continued, the Cambridge University Farm and Mr. Clyde Higgs's dairy farms being described in this number. The economics of farming are represented in an article on changes in beef imports before and after the Ottawa Agreement. The price of the journal is 15*s.*

British Scientific and Technical Books

A SELECT list of standard British scientific and technical books has been issued by the Association of Special Libraries and Information Bureaux. The list has been compiled at the request of the British Council and is planned as a guide in selecting books for a library. It is limited to about 300 works and is not a complete bibliography of the subjects covered, books out of print being omitted. Agriculture and medicine have been deliberately omitted, and the main purpose of the list is to assist in the choice of a collection of British scientific and technical books. Under each main section the books, so far as possible, are placed in a logical sequence of subjects, and it is intended that the ASLIB book list should provide a convenient means of keeping the select list up to date. The list contains a foreword by Sir William Bragg and an introduction by Sir Richard Gregory. The price of the list is 2*s.* to subscribers of the ASLIB book list and 2*s.* 6*d.* to non-subscribers.

Preliminary General Catalogue of Comets

VOL. 1, No. 4 of *Publications of the Kwasan Observatory* contains a catalogue of comets from the year 467 B.C. to the year A.D. 1936. The number of comets listed is 467, and in each case the best available orbit with its reference source is given. The present catalogue is the revision of a catalogue published in 1931 by Prof. Issei Yamamoto in the Astronomical Yearbook of the Oriental Astronomical Association, printed in Japanese. This revised edition of the catalogue by his son, Prof. A. S. Yamamoto, who contributes a preface in English, will be very useful to all students of cometary orbits. A more comprehensive general catalogue is in course of preparation by these authors.

Memorial to Sir Walter Morley Fletcher

AN account of the memorial to the late Sir Walter Morley Fletcher, secretary of the Medical Research Committee and Council in 1914–33, printed for the trustees of the memorial fund by the University Press, Oxford, has been issued to subscribers to the fund. It is illustrated with two plates, one of Miss Dora Clarke's posthumous portrait bust of Sir Walter Fletcher, photographed from the clay model, the other of a corner of the library of the National Institute for Medical Research with the finished bronze in position. After meeting the cost of this personal memorial, the balance of the fund is to be applied for a Walter Fletcher Memorial Laboratory at the Farm Laboratories of the National Institute at Mill Hill. The printed account contains appreciations of Sir Walter Fletcher by Prof. G. M. Trevelyan and Sir Gowland Hopkins.

Rehabilitation of Persons Injured by Accidents

THE Inter-Departmental Committee on the Rehabilitation of Persons injured by Accidents, set up jointly by the Home Office, Ministry of Health and Scottish Office, has issued an interim report (H.M. Stationery Office. 4*d.* net). This report deals particularly with the organization of "fracture clinics".

The object aimed at is the covering of the country with a network of services, for the most part attached to existing hospitals, and based upon a report issued by the British Medical Association in 1935. The need for such a service will be appreciated when it is stated that more than 201,000 new cases of fractures were treated at voluntary and municipal hospitals in Great Britain during 1935.

Science and the Life of the Community

AT the meeting of the General Assembly of the International Council of Scientific Unions last May, a resolution from the Royal Amsterdam Academy of Sciences was adopted (with some modifications) for the appointment of a committee to examine various questions concerned with the practical application of scientific results in the life of the community. That committee has now been constituted as follows: Prof. J. N. Brönsted (Copenhagen), Prof. J. M. Burgers (Delft), Prof. S. Chapman (London), M. Establier (Paris), Prof. B. Nemeč (Prague), M. Francis Perrin (Paris) and Prof. F. J. M. Stratton (Cambridge).

Return of a Large Sunspot

THE leader sunspot of the extensive group, visible from July 22 until August 4, has returned to view, the following component having in the meantime disappeared. The area of this leader spot was about 1000 millionths of the sun's hemisphere on August 20, and on the following day, although the spot was not very far on the disk, it could be seen with the naked eye. The date of central meridian passage is August 25·3, and the sun's west limb will be reached on August 31. Since the spot is situated in fairly high latitude (33° north), its drift backwards in longitude is very marked as compared with the angular rotation of the standard meridian (Carrington's) used in computing sunspot positions and which is given by the mean of sunspots in solar latitude 15°–16° north and south.

The Night Sky in September

ON September 23 at 11^{h} U.T., the sun enters the sign Libra (the autumnal equinox). In the latitude of London, the night is then more than 4½ hours longer than at the time of the summer solstice. The moon is new on September 4 at 22·9^{h} and full (the Harvest Moon) on September 20 at 11·5^{h}. Conjunctions with the planets take place as follows: with Venus on Sept. 2 at 3^{h}; with Mercury on Sept. 6 at 5^{h}; with Mars on Sept. 12 at 18^{h}; with Jupiter on Sept. 15 at 6^{h} and with Saturn on Sept. 21 at 1^{h}. An occultation of the star ξ Sagittarii (magnitude 3·6) occurs on September 14, the disappearance being visible from Greenwich at 18^{h} 37·5^{m}. On September 24, Venus approaches the bright star Regulus. A close appulse of Mars to the 9th magnitude star *C.D.* 11856 will be visible from South Africa on September 7 at about 17·6^{h} U.T. During the month, Finsler's comet in the constellation Virgo continues to move southwards. The following ephemeris is given by Dr. A. D. Maxwell's orbit of the comet:

	R.A.	Dec.
Aug. 31	14^{h} 6·5^{m}	+ 6° 3′
Sept. 4	8·6	+ 1 48
8	10·2	– 1 37
12	11·3	– 4 24
16	12·3	– 6 45
20	13·2	– 8 45
24	14·0	–10 30
28	14·8	–12 3
Oct. 2	15·7	–13 27

There is a faint comet, discovered by Hubble on August 4, in the south-east region of Aquarius. Positions for Encke's comet (passing from Aries to Triangulum) and for comet Grigg-Skjellerup (passing from Ophiuchus to Serpens) will be found in the "B.A.A. Handbook". β Persei (Algol) is now becoming well placed in the late evening for observing the variability of its brightness. The change in light is best seen about 1·5 hours before and after the following times: Sept. 5^{d} 03·5^{h}, Sept. 8^{d} 00·3^{h}, Sept. 10^{d} 21·1^{h}, Sept. 28^{d} 02·0^{h} and Sept. 30^{d} 22·8^{h}. Meteors, the radiant of which is a little south-east of ε Persei, may be looked for from September 7 until 15. The night sky during this month offers an unequalled range of various objects within reach of binoculars or small telescopes. In the middle of the month about 21^{h}, the cluster of the Pleiades will be seen rising in the north-east. (All times are given in U.T.: add 1 hour to convert to Summer Time.)

Announcements

THE bicentenary of the birth of Luigi Galvani will be celebrated on October 18–20 by the town and University of Bologna and the Italian Society of Physics.

DR. MAX WESTENHÖFER, professor of general pathology and pathological anatomy in the University of Berlin, has been elected an honorary member of the Medical Association of Kinesiology at Buenos Aires.

DR. WERNER KUHN, extraordinary professor of physical chemistry at Carlsruhe, has been appointed full professor at Kiel in succession to Prof. Schwarz, who has been transferred to the chair of chemistry at Königsberg.

IN the famous Bialowieza National Park in Poland, a census of the game animals was carried out during the winter 1936–37, and the following count was made: stags 35, deer 78, wild boar 50, wolf 4 (temporary immigrants), lynx 7, fox 8, badger 10, otter 4, marten 5, polecat 19, hare about 30, woodgrouse 30 (*Kwartalny Biuletyn Informacyjny*, 29; 1937).

AN informal meeting to discuss how far scientific workers can help towards the planning of the land of Great Britain, which is one of the important topics of discussion this year at the meeting of the British Association, will be held at Nottingham by the Research Co-ordination Committee (LePlay House, 35 Gordon Square, W.C.1) at the suggestion of the Association of Scientific Workers.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 366.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Biological Effects of the Rays produced by a Cyclotron

BIOLOGICAL effects of neutron-rays from a cyclotron have been reported, on the change of blood pictures in living rats by Lawrence and Lawrence[1], on the retardation of the germination of wheat seedlings by Zirkle and Aebersold[2], and on the fatal dose of the sarcoma 180 by Lawrence, Aebersold and Lawrence[3]. They compared the effects of fast neutrons with those of hard X-rays, and found that neutrons are, in fact, biologically, much more effective than in the case of X-rays.

Apart from these questions of the action of neutrons, we have been engaged in making experiments on histological changes in the organs of a mouse, irradiated with rays produced by bombarding a beryllium target with 2·8 MeV. deuterons from the cyclotron in this Institute.

Healthy male mice weighing 13–17 gm. were chosen for use because of their small size, which made irradiation possible in the limited space available in the cyclotron. A glass cylinder, 2 mm. in wall thickness, 46 mm. in diameter, and 106 mm. in length, was divided into two parts by a glass plate inserted along the axis, one animal being put in each of the partitions. The cylinder was placed in the observation chamber of the cyclotron, and the two mice were irradiated simultaneously under the same conditions. The animals were kept at an equal mean distance of about 8 cm. from the beryllium target. The irradiation was continued for four hours with mean deuteron current of 0·4 microampere.

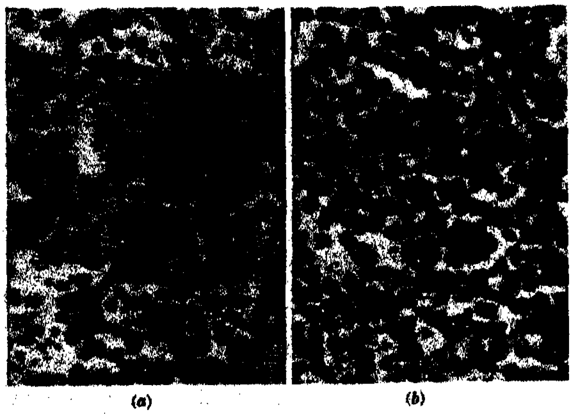
(a) (b)

FIG. 1.

(a) IRRADIATED SPLEEN; (b) NON-IRRADIATED SPLEEN.

As was shown in the laboratory of one of us, histological change of the spleen in the rat, irradiated with X-rays, can be observed best about ten hours after the beginning of irradiation[4].

Therefore ten hours after the beginning of irradiation the animal was dissected; the spleen and testes were taken out, the former being fixed in Helly solution and stained with hæmatoxylin and eosin, while the latter was fixed in Champy solution and stained with Heidenhain's iron-hæmatoxylin as usual.

Fig. 1*a* shows a follicle of the spleen in the irradiated animal, and Fig. 1*b* the same part of the non-irradiated one; in the former, one can observe the remarkable decrease in the number of lymphocytes. Moreover, a large number of strongly stained dots in the same picture shows the destroyed particles.

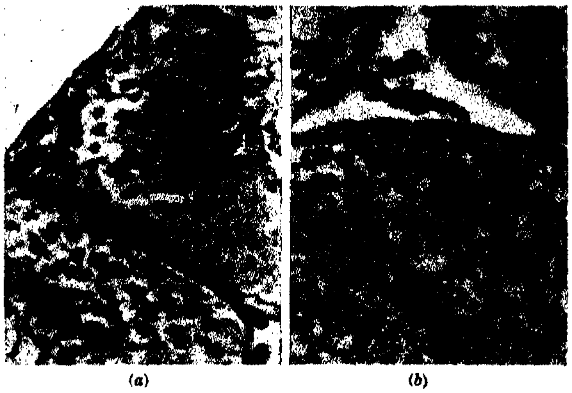
(a) (b)

FIG. 2.

(a) IRRADIATED TESTICLE; (b) NON-IRRADIATED TESTICLE.

In testicles, cells in the various stages of the spermatogenesis are more or less affected and destroyed, but interstitial cells, Sertoli's cells and spermatozoa are relatively intact. Further, one can observe in Fig. 2*a* that there is a diminution in radiosensitivity in passing through the various stages from spermatogonia to spermatozoa.

In conclusion, our thanks are due to Prof. S. Nishikawa and Dr. Y. Nishina for their interest in this work, to Mr. T. Yasaki and Mr. S. Watanabe for their assistance in the physical work, and to Dr. W. Nakahara for his hospitality in keeping our mice. We wish to thank the Japan Wireless Telegraph Company for the electromagnet and other equipments used for the cyclotron, and Mitsui Ho-onkwai Foundation and Tokyo Electric Light Company for financial support.

Nuclear Research Laboratory,
Institute of Physical and
Chemical Research,
Tokyo. July 13.

M. NAKAIDZUMI.
K. MURATI.
Y. YAMAMURA.

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[1] Lawrence, J. H., and Lawrence, E. O., *Proc. Nat. Acad. Sci.*, **22**, 124 (1936).

[2] Zirkle, R. E., and Aebersold, P. C., *Proc. Nat. Acad. Sci.*, **22**, 134 (1936).

[3] Lawrence, J. H., Aebersold, P. C., and Lawrence, E. O., *Proc. Nat. Acad. Sci.*, **22**, 534 (1936).

[4] Motida, N., Sasao, T., and Koenuma, N., *Nippon Rönigen Gakkwai Zassi* (*Japanische Z. Röntgenologie*), 14, 201 (1936); Motida, N., Koenuma, N., and Sasao, T., *Nippon Röntgen Gakkwai Zassi*, 14, 471 (1937).

The Magnetic Field acting upon Neutrons inside Magnetized Iron

F. BLOCH[1] has recently discussed the nature of the magnetic forces between electron and neutron and suggested a quantitative investigation of the magnetic scattering of slow neutrons. We have tried an alternative way of getting some information on these forces by studying the precession of slow neutrons inside magnetized iron, in order to decide whether the magnetic field H or the magnetic induction $B = (1+4\pi\kappa).H$ (κ being the susceptibility) determines the angle of precession[2].

In two previous letters[3], evidence has been given of the precession of polarized slow neutrons passing through a magnetic field which is perpendicular to the direction of polarization. In consequence of the inhomogeneity of the thermal neutrons (C-neutrons) this precession leads to depolarization, the slower neutrons precessing more because they stay longer in the field. Polarized C-neutrons originating from paraffin cooled down to 90° K. should be practically depolarized after passing through 7 mm. of a field of 35 gauss. On the other hand, a field of 2·8 gauss along the same path will give an average precession angle of about 15° only and very little depolarization of the neutrons.

In our experiment, C-neutrons at 90° K. were allowed to pass through an iron polarizer and an antiparallel iron analyser, both magnetized to 14,000 gauss. The stray field outside those two iron bars was less than one gauss. A long coil was interposed between polarizer and analyser, its axis, the fields in the iron bars and the neutron beam being mutually perpendicular. The path of the beam within the coil was 7 mm. Currents producing 2·8 or 35 gauss inside the coil were switched on alternately. Taking more than 600,000 counts with a boron chamber (50 per cent of which were due to C-neutrons) we obtained ($0{\cdot}83 \pm 0{\cdot}26$) per cent more counts with 35 gauss in the coil than with 2·8 gauss. This is the order of magnitude to be expected for the polarization effect according to our previous experiments.

An iron sheet of 0·15 mm. thickness was then placed inside the coil and the magnetic circuit was closed by connecting the ends of the sheet by means of an iron yoke. Another 600,000 counts were taken using the same currents as before. The difference between the number of counts with the high and the low field was only ($-0{\cdot}05 \pm 0{\cdot}24$) per cent this time. It is seen that the polarization effect had disappeared.

We conclude from this experiment that the lower field is sufficient to depolarize the neutron beam entirely when the iron sheet is interposed. Since the path of the neutrons within the iron sheet (where depolarization must have occurred) was only 0·15 mm., the precession of the neutrons inside the iron has to be accounted for by an 'effective field' of $\sim$ 500 gauss or more. The field strength H in the iron was 2·8 gauss only, the induction B was $\sim$ 15,000 gauss; hence B, or at least 0·03 B, must have acted upon the neutrons inside the iron.

O. R. FRISCH.
H. VON HALBAN, JUN.
JØRGEN KOCH.

Institute of
Theoretical Physics,
Copenhagen.
August 5.

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[1] Bloch, F., *Phys. Rev.*, 51, 994 (1937).

[2] The equivalent problem of the deflection of electrons inside magnetised iron has been discussed by C. F. v. Weizsäcker, *Ann. d. Phys.*, 17, 869 (1933).

[3] NATURE, 139, 756 and 1021 (1937).

The Initial Stages of Glycolysis in Muscle Extracts

WE have already made a preliminary report[1] on the preparation from rabbit muscle, by a method involving repeated extraction with phosphate solution, of solutions of the glycolytic enzyme system, which appear to be more free from associated co-enzymes than are extracts prepared by other methods. The extracts convert starch to lactic acid in the presence of muscle *Kochsaft*, but do not do so in the presence of adenosine triphosphate, magnesium ions, cozymase and a trace of hexose diphosphate; an account of their properties, with the evidence of a participation of a new co-enzyme, will shortly be given in detail elsewhere.

In view of the current interest in the earliest stages of the transformation of polysaccharide in muscle extracts[2], we should like to direct attention to the behaviour of the extracts referred to above, in the presence of the co-enzymes, namely, adenosine triphosphate and magnesium ions, which have been regarded by most workers as effecting the initial phosphorylation in the chain of reactions. The points of interest are as follows:

(1) When magnesium ions alone have been added as co-enzyme, no esterification of phosphoric acid has ever been observed.

(2) When in addition to magnesium ions adenosine triphosphate is also present, rapid esterification takes place, and the ester formed consists at first wholly of an easily hydrolysable ester with the properties of the hexose-1-monophosphoric acid recently described by Cori and Cori[3]. In the later stages of the incubation the total amount of esterification increases more slowly and the easily hydrolysable ester is gradually converted into hexose-6-monophosphate. No other ester appears to be formed under these conditions.

(3) The rate of formation of the easily hydrolysable ester is roughly the same over a range of adenosine triphosphate concentrations from M/1,000 to M/10,000, is slightly less with M/50,000 and reduced to about one quarter with M/200,000 adenosine triphosphate. The amount of adenosine triphosphate required is therefore much less than that necessary for glycolysis as a whole to take place with optimal speed, and the amount of ester formed is far in excess of that which could be formed by simple transference of phosphate from the added adenosine triphosphate to the starch. If the mechanism were of this kind, continuous rephosphorylation of adenosine diphosphate or adenylic acid would have to take place, and no means of bringing this about seems to be present. No lactic or pyruvic acid is formed, so that the possibility of rephosphorylation from phosphopyruvic acid is ruled out. Adenylic acid itself brings about no esterification.

(4) The conversion of the hexose-1-monophosphate into hexose-6-monophosphate is much accelerated by the addition of a trace of hexose diphosphate.

The results described above are not in agreement with those reported from Parnas's laboratory[4], where esterification in the absence of any added co-enzyme was observed, or with those of Lehmann and Needham[5], who were able to confirm the findings of the above-mentioned school. The possibility that starch behaves differently from glycogen in this respect is being investigated. But since an easily measurable esterification is produced even by

M/200,000 adenosine triphosphate, one hesitates, in view of the well-known difficulty of eliminating co-enzyme completely from the enzyme system, to accept the evidence for esterification without co-enzymic intervention which has so far been provided.

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July 28.

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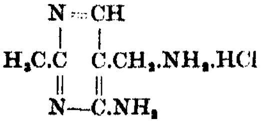
[1] Kendal and Stickland, *J. Soc. Chem. Ind.*, **55**, 1030 (1936).
[2] Needham, *Ann. Rev. Biochem.*, **6**, 401 (1937).
[3] Cori and Cori, *Proc. Soc. Exp. Biol. and Med.*, **34**, 702 (1936).
[4] Ostern, Guthke and Terszakowec, *Z. physiol. Chem.*, **243**, 9 (1936).
[5] Lehmann and Needham, *Biochem. J.*, **31**, 329 (1937).

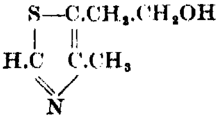
Growth Factors for *Phycomyces*

DURING the last three years, Schopfer has published several papers[1] showing that vitamin B_1 is a growth factor for *Phycomyces*. This mould can now be grown on a synthetic medium composed of glucose, asparagine, inorganic salts and the vitamin. During the last two years, he has described[2] an alternative growth factor ('MP') which differs from the vitamin in being resistant to heat (128° C. for 20 hours causes only 75 per cent loss of activity) and resistant to alkali; it is oxidized by hydrogen peroxide.

Knight[3,4] has shown that his growth factor for *Staphylococcus* consists of three parts, two being the pyrimidine (I) and thiazole (II) components of vitamin B_1 (III), and the third being nicotinic acid or its amide. Very recently Schopfer and Jung[5] have stated that vitamin B_1 can be replaced as a growth factor for *Phycomyces* by the pyrimidine and thiazole components.



I



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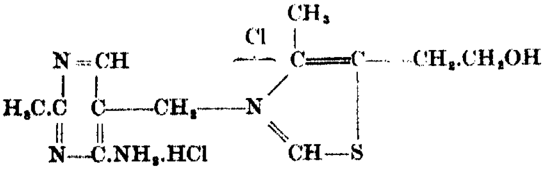

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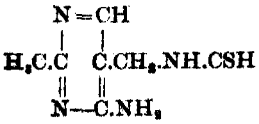
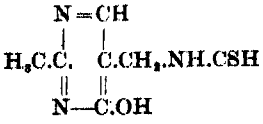


IV



V

Through the kindness of Dr. Todd, I had also been able to test four synthetic compounds (I, II, IV and V) as growth factors for *Phycomyces*. On a medium composed of glucose, asparagine and inorganic salts, no growth is obtained when these four compounds are added singly. But I and II together give a very large growth (cf. Schopfer and Jung), IV and II a fair growth, while V and II give no growth. Further, a neutral solution of vitamin B_1, autoclaved for two hours at 125° C., still acts as growth factor for *Phycomyces*, although the compound is destroyed. The activity of compounds I and IV is not destroyed by this treatment, even in presence of $N/10$ NaOH; hydrogen peroxide, however, destroys the activity. This supports Schopfer's suggestion that his factor 'MP' consists of degradation products of vitamin B_1. There is no doubt that vitamin B_1 itself, as well as its constituents, is a growth factor, since a solution sterilized by filtration through glass instead of by autoclaving remains active. Vitamin B_1 diphosphate ("co-carboxylase" of Lohmann), which was kindly supplied by Prof. Lohmann, is about as active as the vitamin itself.

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June 29.

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[1] Schopfer, *C.R. Acad. Sci.*, **200**, 1965 (1935).
[2] Schopfer, *Z. Vitaminforsch.*, **4**, 187 (1937).
[3] Knight, NATURE, **139**, 628 (1937).
[4] Knight, *Chem. and Ind.*, **56**, 445 (1937).
[5] Schopfer and Jung, *C.R. Acad. Sci.*, **204**, 1500 (1937).

Constituents of Vitamin E Concentrates from Rice- and Wheat-Germ Oils

THE pioneer work of Evans and his collaborators on the anti-sterility factor (vitamin E) has culminated in the isolation from the unsaponifiable fraction of wheat-germ[1] and cotton-seed[2] oils of three apparently isomeric oily alcohols α-, β- and γ-tocopherol of approximate formula $C_{29}H_{50}O_2$, all of which show high vitamin E activity. The use of the unsaponifiable fraction of rice-germ oil as a source of vitamin E was advocated by Kimm[3], who later[4] prepared from a purified concentrate a β-naphthoate, m.p. 156°, which yielded on hydrolysis a product alleged to have very high vitamin E activity.

By acylation of purified concentrates from the unsaponifiable portion of rice-germ oil with *p*-nitrobenzoyl chloride or β-naphthoyl chloride we obtained a complex mixture of oily and crystalline esters. The crystalline esters on separation and hydrolysis yielded three apparently homogeneous crystalline isomeric alcohols of formula $C_{30}H_{50}O$, (*a*) m.p. 121°–122°, (*b*) m.p. 113°–114° and (*c*) m.p. 119°–120°. The alcohol (*c*) yields a β-naphthoate corresponding in its properties to that of Kimm's active material; but like (*a*) and (*b*) it is devoid of vitamin E activity. Of these alcohols, (*a*) may be polyterpenoid in nature but (*b*) and (*c*) are certainly akin to the sterols, being similar in their properties to the tritisterols obtained by Karrer and Salomon[5] from wheat-germ oil concentrates. In a parallel investigation of wheat-germ oil we isolated in similar fashion β-amyrin and two isomeric alcohols $C_{30}H_{50}O$ of the tritisterol type, (*d*) m.p. 113°–114° and (*e*) m.p. 175°; of these (*d*) was also obtained by Karrer and Salomon. Neither (*d*) nor (*e*) possessed vitamin E activity.

The purified oils remaining after removal of these crystalline alcohols from both rice and wheat concentrates had a high biological activity, and gave, on thermal decomposition, considerable quantities of durohydroquinone $C_{10}H_{14}O_2$, which Fernholz[6] obtained by similar treatment of pure α-tocopherol. On treating the oil from the wheat concentrate with cyanic acid in benzene, a mixture of allophanates was obtained from which the products described by Evans, Emerson and Emerson[1] could be isolated, in addition to a crystalline allophanate, m.p. 70°, which has not yet been examined biologically.

The above purified oil from the rice concentrate deposited on standing a crystalline substance, m.p. 73°, which appears to be an aliphatic mono-unsaturated alcohol containing approximately 20 carbon atoms. After removal of this alcohol, the oil on saturation with cyanic acid in benzene solution gave a complex mixture of substances from which a small amount of an allophanate, m.p. 135°–138°, having the properties of β-tocopheryl allophanate[1], could be isolated together with a larger quantity of an allophanate, m.p. 195°–200°; the parent alcohol of the latter substance is being tested biologically.

In view of the formula of the tocopherols and the probability that they may represent mono-alkyl ethers of durohydroquinone[6], the occurrence in active rice-germ oil concentrates of the alcohol m.p. 73° may be of some significance. The work on the structure of these various compounds, of which fuller details will be published elsewhere, is being continued.

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[1] Evans, Emerson and Emerson, *J. Biol. Chem.*, **113**, 319 (1936).

[2] Emerson, Emerson and Evans, *Science*, **83**, 421 (1936).

[3] Kimm, *J. Agric. Chem. Soc. Jap.*, **11**, 514 (1935).

[4] Kimm, *Sci. Pap. Inst. Phys. Chem. Res. Tokyo*, **28**, 74 (1935).

[5] Karrer and Salomon, *Helv. chim. Acta.*, **20**, 424 (1937).

[6] Fernholz, *J. Amer. Chem. Soc.*, **59**, 1154 (1937).

Para-Cresol from the Urine of Pregnant Mares

Burrows, Cook *et al.*[1] have recently isolated *p*-cresol, along with certain ketones of the sterol group, from the urine of a man with a malignant tumour of the adrenal cortex. The urine (30 l.) was submitted to an initial hydrolysis by boiling with hydrochloric acid, and 0·75 gm. of *p*-cresol was isolated from the non-ketonic phenol fraction.

It should be recorded that in this Laboratory a similar observation has been made in regard to the urine of pregnant mares. Approximately 110 gm. of pure *p*-cresol, containing no detectable trace of *o*- or *m*-isomeride, was obtained from 400 gallons of mares' urine, which had been submitted to hydrolysis —a considerably higher proportion than that reported by Burrows, Cook *et al.* for a pathological specimen of human male urine. The significance of this finding is not yet apparent.

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[1] Burrows, Cook, Roe and Warren, *Biochem. J.*, **31**, 950 (1937).

Artificial Release of Crossing-over in Meiosis and Mitosis

THE experiments with artificial production of crossing-over described below belong to a new series which were finished in the spring of this year; they enable us to carry our analysis much further and bring out a series of facts which are entirely new. The following are the main conclusions drawn from this work:

1. (*a*) X-ray treatment of *Drosophila melanogaster* males induces not only spermatogonial, but also meiotic crossing-over.

(*b*) Histological examination of irradiated testes revealed that the early spermatocytes of the first order possess the greatest susceptibility to treatment, whereas the spermatogonia, though also affected, react to a much less extent.

2. (*a*) The mitotic origin of spermatogonial crossing-over induced by X-rays in *Drosophila melanogaster* has been definitely established.

(*b*) The presence of inversions lowers somewhat the frequency of spermatogonial crossing-over throughout the non-inverted region of chromosome III. This proves that there is a similarity between regular meiotic and induced mitotic crossing-over.

(*c*) The frequency of spermatogonial crossing-over is extremely high in the central region (which carries the spindle fibre) of chromosome III. In the remaining regions of the chromosomes there is a closer correspondence with the cytological map than in the case of the normal meiotic crossing-over in females.

(*d*) The frequency of induced crossing-over is higher for later than for earlier spermatogonial stages.

(*e*) The frequency of spermatogonial crossing-over is not proportional to the X-ray dose (a comparison at 1,000 r. and 4,000 r. shows a frequency greater than fourfold in the latter case).

3. (*a*) No oogonial crossing-over was released in female larvæ of *Drosophila melanogaster* with a treatment of 2,000 r.

(*b*) The $\frac{Cy}{b\ cn\ c}$ females used in this experiment showed nevertheless a statistically significant increase in crossing-over between '*b*' and '*cn*'. Since only the gonial stages were irradiated, this result must be taken to mean that there exists an after-effect of the treatment on crossing-over.

4. (*a*) Contrary to the current point of view, which excludes the possibility of crossing-over in the late oocyte of *Drosophila melanogaster*, we were successful in inducing interchange at that stage; this type of interchange we designate as late meiotic crossing-over.

(*b*) This fact raises certain difficulties for Darlington's and Belling's points of view on the mechanism of crossing-over, whereas it favours the interpretation offered by Sax.

From the above summarized results we may draw the following general conclusions:

(1) Crossing-over is a feature to some extent inherent in both meiosis and mitosis.

(2) The absence of regular crossing-over in the gonial stages of gametogenesis in *Drosophila melanogaster* can be explained by the disadvantages somatic crossing-over would offer; the suppression of crossing-over in the soma means its suppression in mitosis and also in the gonial cells.

(3) The hypothesis of Haldane and Huxley, which is based on the disadvantages that crossing-over would offer in the heterogametic sex, does not sufficiently substantiate the nearly complete absence of normal crossing-over in meiosis of *Drosophila melanogaster* males.

A detailed account of the work will appear in Russian (with an extensive German summary) in the *Biologichesky Zhurnal*.

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Cobalt, and Sheep Diseases

IN New Zealand, Askew and his co-workers have shown that cobalt plays a vital part in the healthy life of sheep and that small supplements of cobalt salts will cure sheep suffering from a type of anæmia. Sheep on Dartmoor are liable to a disease very similar in symptoms to those described by the New Zealand workers, and the usual practice of farmers is to send their flocks to lowland pastures in the autumn for two or three months.

Analyses of the cobalt content of the soils from moorland pastures on which sheep suffer and from lowland pastures on which sheep have been known to recover give striking differences which are statistically significant:

Moorland soils on which sheep suffer have a mean cobalt contents of 3·9 parts per million; lowland soils on which sheep recover, 16·7 parts per million.

The figure for the sickness soils is higher than that given by Kidson[1] for corresponding soils in New Zealand, where it was found that sickness was associated with soils having a cobalt content of two parts per million. In the Dartmoor district this figure would be about four parts per million, although occasionally samples have a slightly higher content.

Analyses of pastures show that those in the sickness areas have a mean content of 0·20 part per million cobalt and those in the recovery areas 0·45 part per million.

An examination of soil and pasture composition is in progress, and the relationship of these to the incidence of disease is being studied.

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[1] Kidson, *N.Z.J. Sci. and Tech.*, 18, 694 (1937).

Effect of Occluded Hydrogen on the Rigidity of Metals

AN investigation of the above effect was prompted by an inquiry into the nature of the earth's interior. The existence of a very definite core of radius half that of the earth seems established beyond reasonable doubt by seismology. The nature of this core is puzzling. Tidal phenomena and the Eulerian nutation demand that this core be less rigid than the crust. The noticeable absence of the shear wave on earthquake records of quakes sufficiently distant for the waves to pass through the core (and this, despite the presence of very pronounced compressional waves of the same quake on the record), was taken to mean that the core could not transmit a shear wave. A liquid core was therefore quite generally held to fit in with all known phenomena. However, during the past few years several seismic investigators, after exhaustive study of records, feel reasonably sure that the shear wave does pass through the core, but with greatly diminished energy. This would seem to imply either that a fluid under high pressure can transmit a shear wave, or that the core of the earth is a solid of very low rigidity. The idea suggested itself that a solid solution might satisfy this picture of a solid of low rigidity.

To test this, a solid solution of hydrogen in palladium was experimented with. The first question proposed was, "Does the occluded hydrogen affect the rigidity of the palladium ?" The purpose of this communication is to state that apparently it does. The rigidity was measured by means of a torsion pendulum. A small magnetized needle was suspended by a palladium wire half a millimeter in diameter. The needle was placed in an oscillating magnetic field of variable frequency. The period of the pendulum was obtained by measuring the frequency of the oscillator at resonance, which was found to be quite sharp. In the formula $\mu = 8\pi Il/r^4T^2$ l, r and T were determined before and after occlusion, which was produced by electrolysis. The results were quite erratic, some of the causes of which will be gone into later. However, there was a noticeable change produced in the rigidity of the metal, namely a decrease of rigidity with increasing occlusion. Some twenty different wires were tried and the change in rigidity measured when the wire was saturated with hydrogen. At first fairly long lengths of wire were used, but eventually it was found convenient to use short suspensions about 2·5 cm. long.

The average decrease in rigidity on saturation was found to be 13·7 per cent. The experiments were carried out *in vacuo*, in hydrogen and in air, but beyond a slight change in amplitude of the pendulum, no measurable change in period was noticed in the three cases. The best absolute value of the coefficient of rigidity of palladium into which no excess hydrogen has been forced was found to be $4{\cdot}257 \pm 0{\cdot}030 \times 10^{11}$. All palladium normally contains a certain amount of hydrogen apparently, and if this be driven off by passing a current through the wire, the above figure for the rigidity will be at least 12 per cent higher.

Starting with a piece of uncharged wire, a current of 10 amp. was passed through for a few seconds, heating the wire to redness. The rigidity increased 1·7 per cent. The current was again passed through for about a minute and the rigidity increased a further 8·4 per cent. The wire was then charged with about 400 times its volume of hydrogen. The rigidity decreased 16·6 per cent. Current was again passed through to drive out the hydrogen, this time for several minutes. The rigidity increased 22·8 per cent. The wire was again charged with about 450 times its volume of hydrogen and the rigidity decreased 21·0 per cent. It seems fairly certain, therefore, that the occluded hydrogen causes a decrease in the rigidity of the metal. The investigation is being continued further at Fordham and New York Universities jointly.

Note added in proof: The work of K. R. Koch in this field has not been overlooked, but will be discussed later.

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Kinetics of Catalysed Polymerization of Styrene

INVESTIGATIONS of polymerization kinetics have often required rather cumbersome experimental methods, but Hammick and Langrish[1] have recently applied a convenient bromination method for estimating cyclopentadiene and indene to a study of the polymerization rates of these compounds in carbon tetrachloride. We have been using, for some time, a very similar method to follow the kinetics of the polymerization of styrene, catalysed by anhydrous stannic chloride, in carbon tetrachloride and chloroform solutions at 25° C. The amount of residual monomeric styrene in the reaction mixture is determined, at known intervals of time, by quantitative bromine addition to the double bond, using an excess of bromine which is estimated by titration in the usual way. The accuracy of the analysis (better than 0·5 per cent) is not impaired by the presence of polystyrene; but with polystyrene in the presence of stannic chloride, the excess bromine must be destroyed without delay, in order to avoid a slow attack of bromine on the polymer. The styrene disappearing during polymerization has been proved to be equivalent to the polymer formed by weighing the amount of polystyrene precipitated in methyl alcohol[2]. The polymers produced have molecular weights of the order 5,000 as determined by viscosity measurements.

With specially purified materials, the half-conversion period for polymerization may be of the order of one hour; but complex inhibition phenomena can appear if traces of impurity are present. In one series of experiments, with styrene concentrations up to 1·73 *M.*/litre in carbon tetrachloride, and with commercial 'c.p.' stannic chloride at concentrations 0·01–0·2 *M.*, polymerization was preceded by a period of total inhibition (varying from 0·6 to 4·2 hours with decreasing concentration of catalyst), after which polymerization would proceed to completion with a half-conversion period of one to eight hours. Experiments during the polymerization period have shown (*a*) that moisture produces a retardation inflection in the polymerization curve, (*b*) that dry hydrogen chloride is a temporary complete inhibitor, the polymerization resuming its course after an interval which may amount to an hour or more. In separate experiments, we have found that hydrogen chloride adds to the double bond of styrene at a measurable rate with a stannic chloride catalyst, and that addition proceeds considerably more rapidly in chloroform than in carbon tetrachloride. This behaviour corresponds with the observation that, in pure chloroform, polymerization was preceded by an inhibition period of 0·15 hr. with reactant concentrations which gave inhibition for 1·3 hr. in carbon tetrachloride. (In unpurified, commercial, 'practical' chloroform there was no initial inhibition.)

It seems probable that inhibition of polymerization by hydrogen chloride, introduced by intent or present as an impurity in commercial stannic chloride, is due to saturation by hydrogen chloride of the double bonds of those styrene molecules which have been activated by the catalyst, polymerization being prevented until the inhibitor has been removed by the addition reaction. If this explanation is correct, it follows, as the simplest interpretation (since hydrogen chloride is a *complete* polymerization inhibitor within the analytical error), that styrene and stannic chloride probably form a complex, capable of surviving several molecular collisions, which is responsible both for hydrogen chloride addition to styrene and for the chain-initiation step in the polymerization of styrene. Skraup and Freundlich[3] have provided evidence for the formation of complexes between stannic chloride and certain aromatic hydrocarbons having unsaturated side-chains; and this view of the polymerization catalysis is in accord with recent observations by Gee and Rideal[4].

Detailed experiments are in progress.

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[1] Hammick, D. Ll., and Langrish, D., *J. Chem. Soc.*, 797 (1937).

[2] Schulz, G. V., and Husemann, E., *Z. phys. Chem.*, B, 34, 187 (1936).

[3] Skraup, S., and Freundlich, L., *Annalen*, 431, 243 (1923).

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Polarimetric Studies of Oxide Film Formation on Metals

THE polarimetric method[1] has now been applied to the study of the early growth of oxide films on copper and has given results in general agreement with those obtained by other workers using different methods[2]. Typical curves showing the changes in Δ (the relative phase retardation of the perpendicular and parallel components of the incident plane vibration) during heating and cooling of copper mirrors in dry pure hydrogen and after replacement of the hydrogen by pure dry air, are given in Fig. 1.

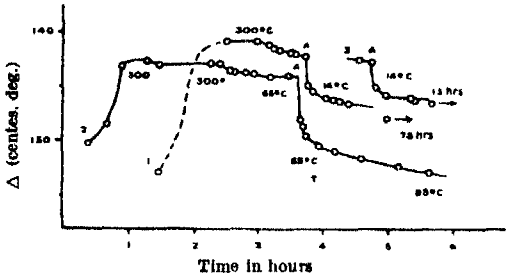

Fig. 1.

A, ADMISSION OF AIR; *T*, TEMPERATURE ROSE DUE TO INADEQUATE CONTROL

Calculations of the film thicknesses corresponding to the optical changes have also been made by means of approximate equations developed in the manner of Drude[3], except that in the case of copper it was not found permissible to neglect some of the terms normally dropped. The thickness curves, together with those of Evans and Miley[4] (dotted) are given in Fig. 2.

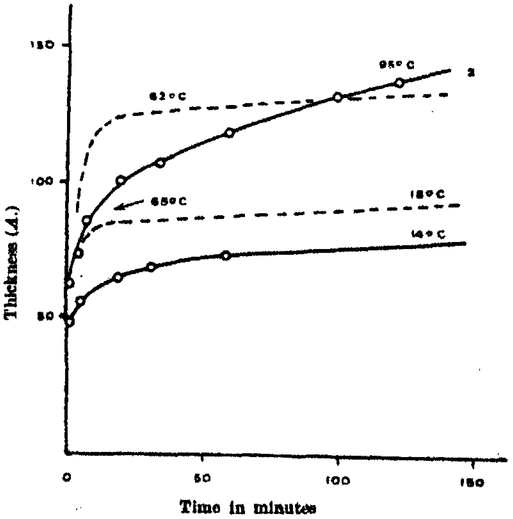

Fig. 2.

These latter would not be expected to be strictly comparable as they refer to oxidation of distorted surfaces beginning during polishing[5], whilst the present results are for the re-oxidation of reduced annealed surfaces. It is also reasonable to expect differing degrees of activation or sintering and partial poisoning by sorbed hydrogen to have direct influence on the course of oxidation and to give rise to second order effects by modification of the optical constants of the base.

However, from this and other work mentioned, it is clear that the magnitude of the first rapid oxidation, even allowing for a considerably greater real surface, is much larger than would be expected from a sorption-diffusion oxidation theory[6]; and it seems that a controlling mechanism must be sought leading to differential equations of a similar form but involving other physical magnitudes. Detailed results and a discussion of them will be published in due course.

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[1] Tronstad, L., *Trans. Faraday Soc.*, **29**, 502 (1933). Winterbottom, A. B., *J. Sci. Instr.*, **14**, 203 (1937).

[2] Evans, U. R., and Miley, H. A., NATURE, **139**, 283 (1937). Dobinsky, S., NATURE, **138**, 31 (1936).

[3] Drude, P., *Wied. Ann.*, **36**, 884 (1889); Tronstad, *loc. cit.* (1).

[4] Evans, U. R., and Miley, H. A., *loc. cit.*, (2).

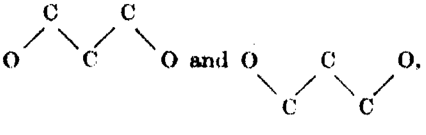
[5] Bowden, F. P., and Ridler, K. E. W., *Proc. Roy. Soc.*, A, **154**, 640 (1936).

[6] Wilkins, F. J., *Phil. Mag.*, **11**, 422 (1931).

Hydrogen Bridges in Solid Pentaerythritol

USING the method of Fourier series, a quantitative crystal analysis of pentaerythritol, $C(CH_2OH)_4$, has now been carried out, and some of the interesting features of the determined structure will be given below.

Of the alternative space groups C_4^5—$I4$ and S_4^2—$I\bar{4}$ chosen first by one of us[1], the latter should now be regarded as the correct one for this compound. The central carbon atom of a molecule is placed at 000 and surrounded tetrahedrally by the four methylenic carbon atoms at xyz, xyz, $y\bar{x}\bar{z}$ and $\bar{y}x\bar{z}$ with $x = 0 \cdot 165$, $y = 0 \cdot 140$ and $z = 0 \cdot 10$, the interatomic distance for the C—C bond being hence 1·57 A. The four hydroxyl oxygen atoms are also arranged in such general positions with the values of the parameters $x = 0 \cdot 313$, $y = 0 \cdot 265$ and $z = 0 \cdot 00$. From these and above values the C—O bond distance is computed to be 1·46 A. The oxygen atoms thus lie in the same plane $z = 0$ as the central carbon and besides not far from the base diagonals. If the hydrogen atoms of the OH groups are not taken into consideration, the molecule possesses approximately the symmetry of $D2d$—$\bar{4}2m$, precisely S_4—$\bar{4}$, with one pair of primary alcohol radicals puckered upwards and the other downwards, namely,



all the bond angles of these atoms being approximately tetrahedral. Such a structure is found in the case of pentaerythritol tetrabromide vapour, in which, according to an electron diffraction study carried out by de Laszlo[2], the bromine atoms in the molecule form a square.

The most interesting aspect of the structure is the close approach of the hydroxyl groups on adjoining molecules. In the plane $z = 0$, four oxygen atoms, one out of each molecule, constitute a square of length of side 2·55 A. This is shown by an idealized figure (Fig. 1), though strictly in the actual case the line joining the central carbon and a hydroxyl oxygen in the molecule makes a small angle with one of the base diagonals.

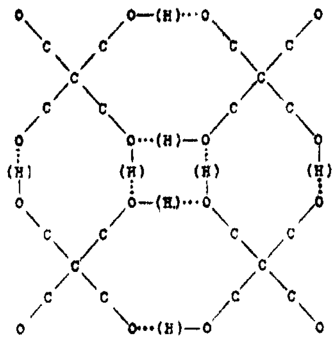


Fig. 1.

The value 2·55 A. for the above O—O distance, which must be bridged by a hydrogen atom, is considerably less than that assigned by Bernal and Megaw[3] to their 'hydroxyl bond', while it is precisely the same as those found in the cases of KH_2PO_4[4] and $NaHCO_3$[5], in which, however, the O—O distance is not between two OH groups but between OH and O. At any rate it is evident that the molecules in a layer parallel to the (001) plane are linked more or less firmly to each other by hydrogen bridges in closed rings, where, according to Huggins[6], the 'synchronized oscillations' may cause an increased stability of the intermolecular linkage. Such layer-like structure explains in a natural way the perfect cleavage along (001).

A detailed account of the present work will be published shortly.

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July 6.

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[2] de Laszlo, H., *C.R.*, **198**, 2235 (1934).

[3] Bernal, J. D., and Megaw, H. D., *Proc. Roy. Soc.*, A, **151**, 384 (1935).

[4] West, J., *Z. Krist.*, **74**, 806 (1930).

[5] Zachariasen, W. H., *J. Chem. Phys.*, 1, 634 (1933).

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Band Spectrum of Thallium Hydride

THALLIUM metal was heated in vacuum resistance furnace, which was filled with hydrogen at 500 mm. pressure. At a temperature of about 1,500° C., some bands in the yellow and red part of the spectrum were emitted. The same bands were also obtained in the emission from a thallium-copper arc burning in hydrogen at high pressure. At low pressure (less than 500 mm. mercury) in the arc no bands were present. With increasing pressure the bands get gradually stronger, and at a pressure of about four atmospheres the yellow and red bands are intense. Under the same conditions in the arc a fainter band system also appears in the blue and violet part of the spectrum.

The spectrum has now been photographed from 8000 A. to 4000 A. One of the strongest bands at λ 5680 is shown in Fig. 1. The band is degraded to the red and consists of two branches, which are designated as *R*- and *P*-branches. Only the first two or three lines in each branch are sharp, and the lines then get gradually wider with increasing *K*-numbers. This widening of the lines, and the fact that no bands appear at low pressure in the arc, indicate that almost every level of the upper state is predissociated. At low *K*-numbers, $0 < K \leqslant 9$, the *P*-lines are single. For $K > 9$ the lines are split up in two components with unequal intensity. As no *Q*-lines are present, the band probably is due to a $\Sigma - \Sigma$-transition. In the thallium hydride molecule, both $^1\Sigma - {}^1\Sigma$ and $^3\Sigma - {}^3\Sigma$ are possible, but since the lines are diffuse (only the first eight or nine *R*-lines are resolved) it is at present difficult to distinguish between these two alternatives.

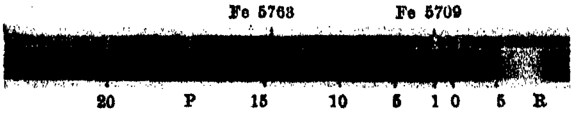

Fig. 1.

A similar but much fainter band lies at λ 6150 A. The two bands have a common upper state, and consequently they are designated as 0 – 0 (ν_0 = 17,519·9 cm.$^{-1}$) and 0 – 1 (ν_0 = 16,174·5 cm.$^{-1}$). The following constants have been calculated: upper state: $B_0 = 4{\cdot}64$; $D_0 = -1{\cdot}18 \times 10^{-3}$ cm.$^{-1}$; lower state: $B_0 = 4{\cdot}73$, $B_1 = 4{\cdot}62$, $D_0 = -0{\cdot}45 \times 10^{-3}$ cm.$^{-1}$.

In the yellow and red part of the spectrum there are also some other bands with a somewhat more complicated structure, which show a characteristic widening of the lines similar to that of the two bands mentioned above. These bands can be followed into the far infra-red part of the spectrum.

Further details concerning the band spectrum of thallium hydride will be published later.

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Points from Foregoing Letters

PHOTOMICROGRAPHS showing the effect of irradiation with neutrons upon the spleen and testicles of mice are submitted by Prof. M. Nakaidzumi, K. Murati and Y. Yamamura. A decrease in the number of lymph cells can be observed in the spleen, while in the testicles, cells in the various stages of spermatogenesis are more or less affected and destroyed.

By studying the precession of neutrons within magnetized iron, Drs. O. R. Frisch, H. von Halban, jun., and Jørgen Koch have found that the 'effective magnetic field' which accounts for the rate of precession is a considerable fraction of the magnetic induction *B*, at any rate much larger than the magnetic field strength *H*.

Drs. L. P. Kendal and L. H. Stickland describe experiments carried out with purified extracts of the glycolytic enzyme system; these may throw light on the earliest stages of the transformation of sugar-like substances, from which the muscle derives its energy. Unlike previous investigators, they find that co-enzymes (both magnesium ions and adenosine triphosphate) are needed for esterification.

Further experiments with substances related to vitamin B_1, which stimulate the growth of the mould *Phycomyces*, show, according to H. M. Sinclair, that pyrimidine plus thiazole give a large growth, and thiazole plus the amide of nicotinic acid give a fair growth (in a medium of glucose, asparagine and inorganic salts), but they are not active separately.

A number of substances separated from the unsaponifiable fraction of rice-germ oil (which has high anti-sterility, vitamin E, activity), together with some of their derivatives, are mentioned by Dr. A. R. Todd, Dr. T. Bergel, H. Waldmann and T. S. Work. Most of these compounds are biologically inactive. An aliphatic mono-unsaturated alcohol containing approximately 20 carbon atoms is considered by the authors of some significance, as a possible simpler derivative of the tocopherols (alcohols of approximate formula $C_{29}H_{50}O_2$) which have been shown to possess vitamin E activity.

Results of X-ray experiments with the fruit fly, *Drosophila*, leading to crossing-over of chromosomes (producing mutation) are described by Prof. H. Friesen. Crossing-over in males was observed in the spermatogonial process both during normal nuclear division and also during the reduction division (meiosis). The frequency of spermatogonial crossing-over is not proportional to the X-ray dose.

Analysis of soils from Dartmoor, where sheep are liable to a type of anæmia (found to be due in New Zealand to a deficiency in cobalt), shows, according to J. B. E. Patterson, that the soil contains only 3·9 parts of cobalt per million on an average, whilst the soil in the lowland pastures, where the sheep are sent to recover, contains on an average 16·7 parts per million of cobalt.

It is stated by Father J. Lynch that when hydrogen is occluded in a metal, it apparently decreases the rigidity of the metal. In the case of palladium the decrease amounts to as much as 23 per cent.

Dr. G. Williams has used a bromination method for estimating styrene to follow the kinetics of its polymerization in carbon tetrachloride and chloroform at 25° C., with anhydrous stannic chloride as catalyst. Polymerization is rapid when specially purified materials are employed, but may be preceded by a period of temporary total inhibition with commercial stannic chloride as catalyst. Hydrogen chloride can act as a polymerization inhibitor, probably by addition to the styrene double bond.

Curves showing that the changes in the relative phase retardation of polarized light, falling upon copper mirrors, during heating and cooling in hydrogen and in air, are given by A. B. Winterbottom, also the film thickness of oxide corresponding thereto. The magnitude of the first rapid oxidation is much larger than expected from a sorption-diffusion oxidation theory.

A quantitative crystal analysis of pentaerythritol by I. Nitta and T. Watanabé has revealed an interesting layer-like structure. Molecules in a layer are linked more or less firmly to each other by the so-called hydrogen bridges, for which the O—O distance is found to be 2·55 A. The molecular shape is similar to that of pentaerythritol tetrabromide in the vapour phase.

Research Items

Ancient Man in Devon

FOR some years past Mr. Reid Moir, in collaboration with Mr. and Mrs. MacAlpine Woods, has carried out archæological investigations in the neighbourhood of Seaton and Beer in south-east Devon. These investigations have been confined to various deposits, ranging from Lower to, possibly, Upper Palæolithic times, situated at some height above sea-level, but until recently no opportunity had appeared for examining the low-lying beds of the river valleys. Fortunately, however, a sewage plant is being erected on the Flood Plain at the junction of the River Coly with the Axe, and from the spoil heaps from the excavations a large number of flint artefacts have been found. The exposed sections are shallow and of small extent, but the succession of deposits, from below upwards, is clearly as follows: (1) Flood Plain gravel; (2) alluvium, with stones, 2 ft.; (3) alluvium, practically stoneless, 1 ft. 6 in. The surface of the Flood Plain gravel at the site examined is approximately 15 ft. O.D. Judging from what has been discovered in other parts of Great Britain, the stony alluvium resting upon the Flood Plain gravel would contain an assemblage of artefacts dating from Magdalenian—late Palæolithic—times to the end of the Stone Age, and it is of interest to note that among the specimens recently found by Mr. Reid Moir and Mr. and Mrs. MacAlpine Woods are a number of blades of flint, including some definite and well-made burins. It is possible that these may be of Magdalenian date, and afford further evidence of the former presence of Palæolithic man in Devon. Other specimens in the series appear to be referable to later epochs, though nothing which can with confidence be assigned to the Neolithic period has yet come to light. The examination of the Colyford site is being continued, and it is hoped that it and the artefacts discovered may be described in the near future.

Potassium and Paralysis

FAMILIAL periodic paralysis, as its name implies, is a hereditary disability characterized by periodic attacks of paralysis usually of the limbs. Aitken, Allott, Castleden and Walker (*Clin. Sci.*, 3, 59; 1937) have recently published observations which promise to illuminate this hitherto obscure malady. A patient was observed who attributed his paralytic attacks to heavy meals. It was found that the attacks could with regularity be produced about five hours after the ingestion of 250 gm. glucose, or by the injection of twenty units of insulin, or most surely by the combined effects of glucose and insulin. Analysis of the blood during and between the paralytic attacks showed that the onset of paralysis was associated with a fall of serum potassium from the normal value of 16–20 mgm. to below 12 mgm. per 100 c.c. serum. The paralysis could be relieved in 15 min. by the ingestion of 12 gm. potassium chloride. A fall in serum potassium occurs in normal individuals when glucose passes from the blood into the tissues, but in periodic paralysis the fall is unusually great, and it is this abnormality which constitutes the essential feature of the disease.

Structure of Protoplasm

DR. A. R. MOORE is probably giving expression to a view very widely spread among biologists when he argues (*Scientia*, 62, July 1, 1937) that the conception of protoplasm as an emulsion, suggested by Bütschli and supported by some of Hardy's experimental results, was quite inadequate even to account for the behaviour of the cytoplasm of the cell. A useful purpose is probably served, nevertheless, in passing in review some of the considerations which suggest a more 'structural' basis. Thus in some merogonic hybrid embryos of echinoderms the *tempo* of cleavage of the cells of the hybrid is clearly determined by the parentage of the cytoplasm—not of the nucleus. In sea-urchin eggs, as the result of centrifugal action, it may be possible to obtain cells, clear of all dense inclusions, which behave quite normally on fertilization, but this clear hyaloplasm, although without visible structure, almost certainly has a structural framework conserving its role in the transmission of hereditary characters. The phenomena of flow in protoplasm is shown to be consistent with the presence of fibrillar elements; in this way alone would it seem possible to explain the behaviour of plasmodia of Mycetozoa, which will flow through hard paper filters with average pore size of 1 μ though they are destroyed when forced through sieve pores less than 0·20 mm. in diameter. Dr. Moore's conclusion, that protoplasm contains polar particles or chains of molecules which, when occasion requires, link themselves into structural features, not only agrees with modern views of the mechanism of wall deposition at the surface of the plant protoplast, but also reconciles very generally the contrast between the mobility of the cytoplasm and the necessity for a structural framework to account for its performance in cell division and heredity.

Researches on Indian Fishes

IN *Current Science*, 5, No. 7, 1937, there are two interesting articles on fishes. The first is entitled "Geographical Distribution of Indian Freshwater Fishes and its Bearing on the Probable Land Connections between India and the Adjacent Countries" by Sunder Lal Hora, assistant superintendent, Zoological Survey of India, Calcutta. It is a summary of the remarks made at the Hyderabad meeting of the Indian Science Congress, during a joint discussion between the Sections of Geology, Botany and Zoology, on Wegener's theory of continental drift with special reference to India and the adjacent countries. The evidence provided by the distribution of the freshwater fishes of India indicates an eastern origin of the fauna and its subsequent dispersal to the west. The close relationship between the Indian and the African freshwater fishes can only be explained on the assumption of a land connexion between the two countries. The absence of the Schilbeidæ from Ceylon and their presence in Africa suggests that Ceylon may have become separated from India at a stage earlier than the severance of the land connexion between Africa and India. In the second paper, P. Sen, entomologist, Bengal Public Health Department, "On the Food Factors of the so-called Mosquito-

Destroying Fishes of Bengal—*Panchax panchax*, *Barbus stigma*, *Esomus danricus* and *Trichogaster fasciatus*", shows that the plankton flora and fauna form the main food of *Panchax* although they also eat insect larvæ, that *Trichogaster* eats plankton with filamentous algæ, and that *Barbus* and *Esomus* are also essentially vegetable feeders. Thus *Panchax* alone of the four eats insect larvæ, and these only form a small portion of the food. There is apparently no justification in assuming that these fishes would eat the *Anopheles* larvæ except in very small numbers.

Inheritance of Leukæmia in Mice

LEUKÆMIA is a tumorous condition in which the leucocytes of the blood multiply rapidly. The symptoms are very similar or identical in mouse and man. There is often enlargement of the spleen and lymphatics as well as an enormous increase of the number of leucocytes in the blood. Dr. E. C. MacDowell (*J. Hered.*, **28**, No. 4) has described experiments on the inheritance of leukæmia in mice which are of particular interest in their bearing on the relation between intrinsic and extrinsic factors. By brother-sister matings through eighteen generations, a genetically uniform leukæmic strain of mice was obtained. In a total of more than 600 mice, however, 10 per cent always failed to develop leukæmia. But the offspring of the negative mice developed the disease with the same frequency of 90 per cent. It is concluded that the 10 per cent negatives represent the balance between the genetic constitution of this particular strain and the particular environment in which they developed. When a negative strain is crossed with a male from the leukæmic strain, the F_1 show an incidence of nearly 45 per cent, and when F_1 males are back-crossed to the neutral strain the incidence of leukæmia is again halved. When the leukæmic heredity is derived from the mothers, the incidence of leukæmia in the offspring is significantly higher in all cases. By careful analysis and variation of the laboratory environment, it will probably be possible to determine which extrinsic factors are effective. It is also significant that the role of extrinsic factors varies with the intrinsic factors present.

Research on Wood-destroying Insects

THE *Journal of the Royal Society of Arts* (**85**, 407; 1937) contains a report of a lecture given by Dr. R. C. Fisher of the Forests Products Research Laboratory on the above subject. Special reference is made to the death watch beetle (*Xestobium rufovillosum*), and it is pointed out that there appears to be a definite relation between the presence of fungal decay in timber and the occurrence of this insect. It was also shown that the temperature and moisture content of timber are important factors in determining the rate of development of the beetle. Warm, dry conditions and the absence of fungal decay are unfavourable for this insect. Damage is usually most severe at, and often confined to, the built-in ends of timbers in buildings where ventilation is poor and where conditions are favourable for the accumulation of moisture and consequent risk of decay. The outstanding conclusion of recent biological studies is the importance of the presence of fungal decay. Experiments are in progress to determine exactly how fungal decay renders timber suitable for infestation. Also the fact that *Xestobium* can continue to live and develop very slowly in decay-free timber has to be taken into consideration. Reference is made to frequent reports in the press, and by authorities seeking funds for repairs, of damage caused by the beetle to churches and other buildings. The result has been a general impression that the creature has increased its activity during the last few years. This idea, however, is erroneous, and the apparent spread of the beetle can be best explained by the increased interest taken in its occurrence, which leads to more thorough inspection of old timbers in buildings.

Cytology of the Genus *Poa*

J. M. ARMSTRONG has examined the chromosome numbers of twenty species of the grass *Poa*, with the result that previous suggestions are confirmed and extended: (1) that polyploidy is associated with species formation; diploid to dodecaploid species are described, the basic chromosome number being seven; (2) that aneuploid species are also present; three aneuploid species have chromosome numbers suggestive of a 9*n* origin (*Canadian J. Res.*, **15**, June 1937). An interesting examination is made of the possibilities of the maintenance of a certain aneuploid strain with 54 chromosomes. In view of the obvious difficulties in the way of maintaining constant such an aneuploid strain through normal sexual fertilization, an apogamous origin of embryos from sporophytic tissue in the ovule seemed likely and has frequently been suggested. Armstrong, however, shows that the fertility of the pollen mother cells is surprisingly high and that polyembryony frequently occurs, but that the embryo sacs may all arise from megaspores produced after the normal reduction division. The author points out that the univalent chromosomes appear regularly to be included in the nuclei after reduction division. Four univalents are concerned, and in view of the high chromosome number their presence may not disturb the genetic balance if they undergo random segregation. Such random segregation would give 6 out of 16 pollen grains with 2 univalent chromosomes and, in view of the frequent occurrence of polyembryony, with good opportunities of meeting female nuclei with 2 univalent chromosomes also. Such gametes would contain 27 chromosomes in all and their union might maintain the strain by ordinary sexual reproduction; the author concludes that this is the method in which the aneuploid 'Mammoth' strain of *Poa pratensis* is reproduced.

Fulgurites from Witsands, Kalahari

AMONG the sand-dunes on the south-east border of the Kalahari desert, A. D. Lewis (*S. Afr. Geog. J.*, **19**, 50; 1936) estimates that there are not fewer than 2,000 fulgurites ('lightning tubes') over an area of eight square miles. Curiously, however, the natives say that storms are not frequent and they have never seen the dunes struck by lightning. The friable tubes of fused silica are mostly found as broken fragments lying in the hollows between the dunes, and only rarely are they seen *in situ* projecting a few inches above the surface of the sand. Five tubes extending vertically downwards were excavated, but without reaching the lower end. The longest recovered (as fragments) measured 8 feet and showed some branching with a variable form and diameter (0·2–0·5 in.) along its course. Larger tubes (up to 2 in.)

have collapsed with the formation of longitudinal ribs. In one case threads of fused silica extend across the cavity, suggesting that the tube again expanded while still in a plastic condition. The sand surrounding the longest tube was seen to be "darkened as if burnt". Some previous records mention that the loose sand adjacent to the fulgurite is iron stained, suggesting that iron was vaporized from the fused silica. The author accepts, though apparently somewhat reluctantly, the view that these tubes were formed by lightning. One of his alternative suggestions is that they were formed by meteorites; this being supported by the statement that lechatelierite (silica-glass) has been found in meteorites—a statement that is quite incorrect.

The Baffin's Bay Earthquake of 1933

LATE on November 20, 1933, a strong earthquake was recorded at stations all over the world. The early estimates made at Kew, Strasbourg and elsewhere showed that the epicentre lay in Baffin's Bay, and, about a week later, it was reported that the shock was felt in western Greenland. The earthquake is one of much interest, for we have no record of any other in this part of the world, and the epicentre was so situated that the numerous stations in Europe, North America and Japan all lay within moderate distances from it. In response to circulars issued by Dr. A. W. Lee of the Kew Observatory, 99 records were placed at his disposal, more than two thirds of them from stations lying between 25° and 40° from the origin, and these are studied by him in a recent valuable memoir (*Meteorol. Office, Geophys. Mem.*, No. 74; 1937). The closest representation of the travel of the *P* waves to distances of 25°–50° is, he finds, given by a table based on one prepared by Gutenberg and Richter, the resulting position of the epicentre being lat. 73·3° N., long. 70·2° W., and the time at the origin 23h. 21m. 31·5s., G.M.T. The surface waves were very large, showing that the focal depth was not considerable. Indeed, from the average length (about 4 sec.) of the interval between the arrivals of the *P* and *sP* waves, it follows that the depth was about 10 km. below the surface. The apparent velocity of the *P* waves was uniform for epicentral distances from 25° to 40° and again from 45° to 50°, the velocity changing by 17 per cent from 40° to 45°. There are discrepancies between the observations of *S* and the existing tables. A new table for *S* for distances 25°–50° was, however, computed from the travel-times for *P* on the assumption that Poisson's ratio is constant for the rocks traversed by the waves, and the agreement between the observations and this table is satisfactory.

The Tenham Meteoric Shower of 1879

IN 1935, a collection of 102 complete meteoric stones, of aggregate weight about 108 lb., was presented to the British Museum by the widow of Mr. Benjamin Dunstan, formerly Government geologist of Queensland, who had been collecting information of the history and composition of the meteorites. This collection, described by Dr. L. J. Spencer in No. 156 of the *Mineralogical Magazine*, represents a remarkable shower that fell in 1879 at Tenham in a remote district of south-west Queensland. Thirty years ago, two large stones and one small stone (total weight, 134 lb.) from this district were acquired for the British Museum. Dr. Spencer relates the history of these three "Warbreccan stones", which are almost certainly three belonging to the original collection made by Mr. M. Hammond, an eyewitness of the fall and who was alive in 1936. A chemical analysis of specimen stones made in the Government Chemical Laboratory at Brisbane in 1913 shows that their composition is that characteristic of the stony variety, that is, masses of crystalline rock with a small metallic content, as distinct from the type composed largely of metallic iron. This collection from the Tenham shower is stated to be the most complete example of a meteoritic shower in the British Museum collection of meteorites. Dr. Spencer describes schematically the passage of a stony meteorite through the earth's atmosphere, its stage of incandescence commencing at a height of about 100 miles; the subsequent explosion of the meteorite due to intense surface heating and to air pressure, followed perhaps by a second explosion and the fall to earth of the resulting shower of stones, the velocity of which is checked generally to that of an ordinary falling body—about 70 metres a second. In the case of a large mass of metallic iron, it will survive disintegration more easily and may arrive at the earth's surface with much greater velocity.

The Cannizzaro Reaction

THE mechanism of the Cannizzaro reaction, in which an aldehyde, for example, benzaldehyde, reacts with water in the presence of an alkali to give an acid and an alcohol ($2R.CHO + H_2O = R.COOH + R.CH_2OH$) has been investigated by using alkali dissolved in deuterium oxide, D_2O (Bonhoeffer and Fredenhagen, *Naturwiss.*, 25, 459; 1937). No deuterium was found in the CH_2 group of the alcohol. This means that the hydrogen from one aldehyde group is transferred directly to the carbon atom of the other aldehyde molecule (possibly after the two molecules have combined to give an acetal compound), without a dehydration of a hydrated aldehyde molecule and transference of molecular hydrogen.

Tests for Random Observations

W. O. KERMACK and A. G. McKENDRICK (*Proc. Roy. Soc. Edinburgh*, 57, 228; 1937), starting from an investigation of the fluctuation in the death-rate from ectromelia in mice in an experimental epidemic, have arrived at simple tests which will help to decide whether a series of numbers is *random*, that is, due to mere chance, or evidence of a real cause. A series which conforms to these tests is not necessarily random, but is likely to be so. On the other hand, failure to conform is evidence of non-randomness. The calculation depends on the *runs* and *gaps*, the average lengths and standard deviations of which are compared with what would be expected from pure chance. One obvious limitation of the tests is that they make use only of qualitative relationships and do not take into account exact magnitudes, so they do not make full use of the information available. On the other hand, there is the compensating advantage that no assumption is made about the law of distribution of the observations. These tests are applied to some examples, including Tippett's random numbers, telephone numbers, duration of measles epidemics, Swedish death-rates, Edinburgh rainfall and Edinburgh temperature. The results work out as might be expected in most cases, but the Edinburgh climate seems to defy prediction.

The First International Acoustical Conference

THERE is scarcely any subject which, during the last few years, has assumed greater commercial and social significance than acoustics. Alongside has come the steady growth of noise—that is, unwanted sound—which in its many aspects is beginning to stir the consciousness of the public to such an extent that it is demanding measures for relief in the more outstanding cases. Acoustics has furthermore developed a large specialized terminology, and the need for agreed measuring units and standards has become more and more pressing.

In Great Britain such questions have been dealt with by a British National Committee under the auspices of the British Standards Institution. Under the chairmanship of Dr. G. W. C. Kaye, this Committee has developed and classified an extensive glossary of acoustical terms*, particular attention being given to units and standards, among them the scales and units of loudness and energy-level. As regards these latter, which are of especial importance, considerable divergencies have unfortunately prevailed in the practices of different countries, not only as regards the scales, units and zeros of the standard reference tones, but also in the listening techniques and phraseology employed. In its work, the British Committee kept in mind the desirability of eventual international agreement in such matters and to this end set up specifications dealing with the standard reference sound (a sinusoidal plane progressive wave of a frequency of 1000 cycles per second), and the arbitrary zero of reference (0·0002 dyne per sq. cm.). The "phon" (a name we owe to Barkhausen) was adopted as the unit in the subjective scale of equivalent loudness, while the use of the "decibel" (a name which originated in America) was restricted to the scale of the associated energy or pressure level.

In July of this year, the first international conference on acoustics was summoned in Paris under the auspices of the International Electrotechnical Commission (I.E.C.), some sixty delegates from thirteen countries assembling under the presidency of M. Duval, president of the French Electrotechnical Committee. Substantial agreement was reached in the several sections set up to deal with vocabulary, fundamental units and methods of measurement, electro-acoustics, and noise abatement. Chief interest centred in the questions of fundamental units and methods of measurement, and it is satisfactory to learn that the proposals eventually adopted are in complete agreement with the specifications submitted by the British delegation under the chairmanship of Dr. Kaye. The "phon" and the "decibel" are accordingly accepted as international units, so that an important contribution to international acoustical measurements has been achieved. Particular mention should be made of the helpful and conciliatory outlook of the United States and German delegations, of whom Dr. Harvey Fletcher and Dr. Grutzmacher were the respective chairmen.

An inquiry into the present position of objective noise meters indicated that while great progress had been made, there was not enough experience available to approve at the present juncture the specification and standardization of a 'universal' noise meter which will measure on the phon scale any and every type of sound. Other points dealt with included the standardization of methods of testing microphones and loud-speakers, the different procedures adopted in various countries for measuring acoustic absorption coefficients by the reverberation method, the methods used to investigate the transmission of air-borne and impact sounds in buildings, and the steps taken in different countries for reducing noise.

The pronounced success of the Conference owed much to the valuable preparatory work of the I.E.C. and the co-operation of M. Valensi, secretary of the Comité Consultatif International Téléphonique. It was agreed at the final plenary meeting that the work of future conferences should be administered by the Federation of National Standardising Bodies known as the International Standards Association, the I.E.C. concurring and actively collaborating.

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* "British Standard Glossary of Acoustical Terms and Definitions" (London: British Standards Institution, 1936) 3s. 6d. net.

Concentration of Solutes in Vacuolar and Cytoplasmic Saps

By Dr. E. Phillis and Dr. T. G. Mason, F.R.S.

IF 25–30 gm. of mature leaves of the cotton plant are rolled up, wrapped in cloth, the wad placed between two disks about 2 in. in diameter and the whole put in the jaws of a small vice, sap is expressed on the application of pressure. As the sap flows out of the wad, much of the leaf is squeezed out from between the disks. To obtain more sap, the tissue must be collected into a ball and again wrapped up in the cloth. On the application of pressure, sap is again expressed. This process can be repeated three or four times; but a point is reached when even under the greatest pressures that can be obtained in the vice, the yield of sap amounts to only a few drops. If now the residue from which sap has been expressed is frozen at −16° C. and then thawed, much more sap can be obtained on the application of very small pressures.

It was observed by Dixon and Atkins[1] that the concentration of solutes increased in successive fractions. They also discovered that preliminary treatment of the leaf by freezing or by exposure to anæsthetics greatly increased the concentration of solutes over that in sap expressed from untreated tissue. Typical results from our own experiments for calcium, magnesium and potassium are shown in Table 1.

TABLE 1. SAP EXPRESSED IN VICE.

		No. of fractions			Frozen residue
		1	2	3	
ml. sap from 100 gm. fresh wt.		11·2	11·4	12·7	28·6
Concentration (mgm. per 100 gm. water)	Calcium	490	525	568	848
	Magnesium	54·4	57·3	61·2	99·7
	Potassium	201	218	238	204

It will be seen that much sap was released and that there was a marked increase in the concentration of solutes as a result of freezing the residue. The usual explanation (Walter[2]) for the increase in concentration in successive fractions is that pressure has two effects, one being the expression of water through the cytoplasm and its membranes, solutes being retained in the vacuole, and the other the bursting of cells and consequent liberation of vacuolar solution. The change in concentration in successive fractions is assumed, therefore, to be due to filtration of water and concentration of the vacuolar solution. The increased concentration resulting from freezing is generally interpreted as due to the breakdown of impermeable membranes and the release of the vacuolar sap. It is very commonly assumed by botanists (Scarth and Levitt[3]) that the cytoplasm in mature leaves contributes but little sap and that the bulk of the sap expressed even from previously frozen tissue comes from the vacuole. Perhaps it is also true that many botanists still believe that the continuous phase of cytoplasm is water (cf. Stiles[4]), and that some of this water may be expressed, particularly after coagulation of the cytoplasm which is assumed to occur as a result of freezing.

Somewhat to our surprise, we have observed that if leaves are carefully placed one on top of another between the relatively large plates of a hydraulic press, the concentration of sap in successive fractions does not necessarily increase as the pressure is increased. The concentrations are also found to be lower than when leaves are pressed in the usual way in the vice. In the hydraulic press, using carefully arranged leaves, they are not squeezed out from between the plates, and the shearing forces that arise in the vice, as leaves are redistributed in the wad as its shape is changed, are negligible or absent. The presence or absence of shearing forces appears to be crucial. The results for a duplicate sample of leaves to that used in Table 1 are shown in Table 2.

TABLE 2. SAP EXPRESSED BY HYDRAULIC PRESS.

		No. of fractions			
		1	2	3	Frozen residue
Pressure (lb. per sq. in.)		6,000	10,000	16,000	16,000
ml. sap from 100 gm. fresh wt.		13·1	13·5	11·6	28·5
Concentration (mgm. per 100 gm. water)	Calcium	420	414	424	886
	Magnesium	46·9	44·5	46·5	107·2
	Potassium	162	181	176	253

It will be seen that there is again a great increase in concentration when the residue is frozen and pressure applied. Of outstanding importance is the fact that the concentration remains nearly constant and does not rise as the pressure is increased. There is thus no support for the view that water is filtered under pressure through the cytoplasm. Other causes for the increase in concentration in the vice must therefore be sought. It will be noticed that even the first fractions in the vice exceeded those in the hydraulic press. If the results are graphed, it will be seen that the curves for the two methods of expressing sap diverge from a common origin. It is noteworthy that even under pressures so high as 16,000 lb. per sq. inch, only approximately half the sap was expressed.

The meagre proportion of the total sap present in the leaf that can be expressed by these high pressures does not indicate that the continuous phase of cytoplasm can be water, as is generally assumed, for as much water can be expressed from a gelatin gel under a pressure of 2,000 lb. per sq. inch as is liberated[5] by freezing at −20° C. It must be borne in mind that nearly half the volume of the mesophyll cells in cotton, excluding the cells' walls, consists of cytoplasm. This is contrary to what is usually believed to be the case (cf. Stiles[4]); but Iljin's[6] measurements show that cotton is by no means exceptional in this respect. It would seem that the continuous phase of active cytoplasm, as Lepeschkin[7] suggests, is a liquid, composed probably of proteins, lipoids and water. This liquid, as we have previously[8] suggested, would appear to have solubilities and diffusion constants quite different from those of water, and to be dependent for its origin and maintenance on respiratory energy. With such a concept of the composition of the continuous phase of cytoplasm, the results already described would be explained as follows.

When the leaf is pressed in the hydraulic press, the vacuolar sap escapes through fissures in the cytoplasm. The continuous phase of the cytoplasm, for which Lepeschkin has proposed the term 'vitaid', is not decomposed by this direct pressure into its component parts. In the vice, on the other hand, shearing forces are operating. We thus assume that the 'vitaid' molecule is decomposed by comparatively small shearing forces though able to withstand direct pressures of considerable magnitude. Thus in the vice a gradual decomposition of the 'vitaid' molecule occurs. It is broken up into proteins, lipoids and water, while the solutes which were in solution in it are now dissolved in the water and escape with the vacuolar sap, which in the leaf of the cotton plant is considerably more dilute than the sap that is produced as a result of the decomposition of the 'vitaid' liquid. The great increase in concentration and the large amount of sap produced when the residue from the hydraulic press is frozen is due to the decomposition of the 'vitaid' liquid by the shearing forces that arise as a result of the formation, and perhaps the disappearance, of ice in the vacuole and the intercellular spaces.

Some confirmation of this hypothesis is furnished by the following experiment, the results of which are shown in Table 3. If the residue from the hydraulic press from which all the sap available at a pressure of 14,000 lb. per sq. inch has already been expressed, is divided into two portions, one of which is frozen and one of which is gently rubbed between the fingers and thumb, it will then be found that further sap can be expressed from each portion merely by squeezing in the hand. The volume obtained after rubbing, as might be expected, is slightly less than that after freezing, for the shearing is less thorough. The concentrations in the two residue saps were approximately equal in this experiment, although in other experiments, those in the finger-rubbed fractions have been slightly below those in the frozen fractions. The maximum pressures used give no indication of the ease of expression of sap. From the fresh tissue, no sap was obtained below a dial reading of 4,000 lb. per sq. inch hydraulic pressure, while with both the residues, most of the sap was expressed before the needle left the zero mark.

TABLE 3. EFFECT OF PREVIOUS TREATMENT OF RESIDUE ON SAP OBTAINABLE UNDER PRESSURE.

	Fresh leaves	Treatment of residue	
		Finger-rubbed	Frozen
Maximum pressure (lb. per sq. inch)	14,000	14,000	14.000
gm. sap from 100 gm. fresh weight	24·4	30·9	36·7

		Fresh (hydraulic pressing)	Residue treatment	
			Finger-rubbed	Frozen
Concentration (mgm. per 100 gm. water)	Calcium	266	718	712
	Magnesium	44·0	104·7	106·6
	Potassium	275	599	604

It is interesting to note that Audus[9] has found that rubbing a leaf on both sides with a finger stall or merely bending the leaf increases respiration 2–3 fold.

If we are correct in the interpretation of the results, we can form *approximate* estimates of the concentrations of solutes in the vacuole and cytoplasm respectively. The vacuolar estimate is obtained from the lowest concentration obtainable by direct pressing. This may be an over-estimate, for slight shearing forces will cause some cytoplasmic decomposition; for example, when brittle leaves are pressed in the hydraulic press, successive fractions of sap show diminishing concentration, due, we believe, to shearing forces developed in the leaf mass during the initial stages of compression. The action of such shearing forces is associated with the presence of chloroplasts in the expressed sap. If the vacuolar sap could be completely expressed the residue should, on decomposition, yield a sap representative of the cytoplasm, but incomplete vacuolar pressing will cause dilution of the cytoplasmic sap and an under-estimate of its concentration. In the leaves used in the experiment just described, the concentration in the cytoplasm must have been more than double that in the vacuole.

Methods used for the extraction of sap invariably include some process which we believe leads to destruction of the 'vitaid'. These processes include boiling[2], freezing, grinding[10] and treatment with anæsthetics[11]. All saps obtained by these processes are, therefore, mixtures of vacuolar sap with that produced on decomposition of the vitaid. It will be necessary in the future, we think, to distinguish between the true (vacuolar) sap and that derived from the destruction of the cytoplasm.

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International Congress for Short Waves in Physics, Biology and Medicine, Vienna*

PROF. H. THIRRING, in an address made during the opening ceremony of the Short Wave Congress held in Vienna on July 12–17, referred to the many fields of application of Hertzian waves in research, medicine and radio technology. These fields are to some extent interdependent, and there are in particular medical and biophysical problems which require the collaboration of biologists, physicists and radio-engineers if they are to be solved satisfactorily. Thirring pointed specially to the urgent problem of dosage measurement in short wave therapy and to the fundamental scientific question of the mode of biological action of short waves: specific or thermal. These problems occupied a prominent position in the Congress, and, together with purely physical papers, will form the substance of the present report; the review articles in the various sections and the fifty or so papers in the medical section will not be dealt with. (Number in brackets in each heading indicates the number of papers presented.)

(1) *Production of ultra-short waves* (11). Most of the papers dealt with retarding field or magnetron circuits devised for production of the shortest waves; the most interesting perhaps was the 14 cm. wave retarding field generator with resonant cavity as frequency stabilizer, demonstrated by Dällenbach, Alderding and Kleinsteuber. The demonstration showed the remarkable frequency stability attained and the modulation of the 14 cm. wave. Another retarding field system was described by Meng and Potapenko, who have constructed exceedingly symmetrical micro-tubes for high-order oscillations of wave-length ∼ 1 cm. McArthur described a new

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* Internationaler Kongress für Kurzwellen in Physik, Biologie und Medizin. Referate und Mitteilungen. (Wien: Brüder Hollinek, 1937).

magnetron, of single (water-cooled) anode type with permanent magnet and concentric tube transmission line, giving 10 watts at λ 4·8 cm. Groskowsky and Ryzko discussed the increased efficiency obtainable with 4-anode magnetron tubes when the usual tungsten cathode is replaced by oxide-coated nickel. The Okabe electron beam magnetron was described by Joji Ito.

(2) *Transmission : Ionosphere research* (12). Van der Pol sketched a theory of propagation of ultra-short waves over the earth, starting from the Maxwell equations, with proper boundary conditions ; he showed that 7 m. waves must diffract considerably beyond the horizon, with a strong attenuation which is due to absorption by the ground. Southworth discussed transmission in pipes or cylindrical rods of dielectric. For a hollow metal pipe the diameter must be at least 0·58 λ. The resonant cavity is a special case of this system, and may be used as a frequency determining unit or as an impedance matching device, and perhaps as a new means of 'irradiating' laboratory specimens.

Six of these papers dealt with the ionosphere, beginning with a review by Zenneck. Burkard discussed the information concerning the ionosphere and its diurnal and seasonal variations obtained from a statistical treatment of amateur radio reports—as many as 10,000 per month. Reports for the summers 1934 and 1935 (sunspot minimum—single reflection, presumably from F_2) gave 240 km. as the mean height of the layer. Ito Yoji described ionosphere studies during the total eclipse of June 19, 1936, when there was found 47 per cent decrease in electron density in F_1, but practically no effect on F_2. Fuchs described a method of determining the absolute temperature in the ionosphere, obtaining the values $F_1 > 400^\circ$, $F_2 > 1{,}400^\circ$ K., so that the daily division into the two layers is presumably due to gas-thermal effects. Hals described the discovery of the Hals-Störmer echoes, and Fuchs provided an interpretation, as an ultra-violet ionization phenomenon of the upper atmosphere.

(3) *Absorption and dispersion in chemical systems* (4). Potapenko described a new modification of the Drude-Coolidge method for determination of ε' and ε'' ; together with Keutner, he has used the method for measurement on monohydric alcohols and glycerol, finding, as others have found, approximate agreement with the Debye theory. Williams has measured the absorption of 1·25 cm. waves by ammonia gas, the ray being diffracted from an échelette grating after passage through the gas, and the intensity being determined with a crystal detector.

(4) *Dielectric properties of tissues : heat production in tissues and tissue models* (4). The papers on this subject brought out clearly the large number of factors which must be taken into account in considering the possibility of selective heating of tissues by ultra-short waves. Given fixed values of ε (dielectric constant) and $\varkappa$ (specific conductivity) for the various parts of a body, the matter is relatively simple ; if, however, both ε and $\varkappa$ are strongly dependent on frequency and on temperature, the calculation of the optimal wave-length for selective heating of a certain tissue becomes impossible without complete experimental dispersion curves for all the tissues concerned. In regard to $\varkappa$, Schaefer and Rajewsky have now extended their measurements on blood to several other tissues, while an admirable series of measurements by K. Osswald shows the dependance of both ε and $\varkappa$ on frequency even in the ultra high-frequency region. A further complicating factor may be the very large effect of field intensity on dipole losses in solutions of *zwitterions*, observed by Schmelzer in the case of tetra-*n*-butylammonium bromide in benzene, although it is not yet known what proportion of the observed high-frequency conductivity of tissues is due to substances of this type.

This complexity in the physical properties of heterogeneous systems makes it important to obtain empirical information concerning selective heating by experiments with 'models', however approximate such information may be. Pätzold described measurements of the relative heating of juxtaposed layers of fat and muscle in the condenser field at λ 6 m. and 1 m., the results of which are in substantial agreement with those calculated from Osswald's data. He has also measured the relative heating of layers of salt solutions in a solenoidal field as a function of position, wave-length and number of coil windings, and further considered the possibility of applying ultra high-frequency energy by 'irradiation', on the basis of *Halbwertschicht* determinations on salt solutions and tissues at λ 4·3 m.

(5) *Physics and chemistry of possible specific (non-thermal) effects* (17). It soon became clear that 'non-thermal' effects might be placed in several categories : (*a*) Specific electrical and mechanical effects, the existence of which, in principle, can scarcely be doubted, resulting in chain configuration of suspended particles, in decreased degree of dispersion, change in viscosity, etc., dependent on field strength and type of field but not on frequency. These effects were admirably discussed by Krasny-Ergen. (*b*) Possible specific chemical and biochemical effects, the existence of which has not yet been satisfactorily demonstrated, although frequently asserted. These were discussed by Königer, who suggested possible 'resonance' absorption effects, in the sense of Romanoff's theory. Bateman and Rosenberg discussed the physical conditions which have to be satisfied for the experimental elimination of thermal effects. (*c*) Possible non-thermal physiological effects on cell suspensions, when thermal effects can be avoided by use of proper experimental conditions. According to Haschė, Leunig and Loch, the field has no effect on *B. coli* and *Staph. pyoceanus aureus* under most conditions of wave-length, intensity and type of suspension medium, although a few inconsistent observations have been made at λ 3·5 m. ; similar negative results were obtained by Ruete with *B. coli* and several moulds, and by Malov, with *Drosophila* (mutation rate and lethal action). The observations of Roth (development of exposed seeds), of Wertheim ('biopositive' effects on yeast) and of Schweinburg (on rabies virus), with their less satisfactory control of heating, do not necessarily contradict these negative results. (*d*) Effects on large bodies : 'specific' effects opposite to 'heating' effects. Most of the observed physiological effects belong in this category ; they could be the result of (*a*) or (*b*), or else—more probably—merely thermal effects of a special kind, due to the peculiar distribution of temperature gradients in the body which results from exposure to the field. None of the many experiments of this type described at the Congress contributed essentially to the solution of the problem.

(6) *Measurement of absorbed energy in ultra-short wave therapy* (9). The difficulties of a satisfactory measurement of 'intensity' (watts absorbed/sec.) were enumerated by several contributors, and a number

of modifications of known procedures were described. In particular, Mittelmann has used a method involving the preliminary determination of the effective resistance of the circuit with a secondary transmitter and valve voltmeter, followed by measurement of *I* or *E* during treatment with thermo-cross and dynamometer. Riesinger measures the total anode dissipation of his transmitter with ammeter and voltmeter, and the heat dissipation with a photo-cell and a reflecting bimetal strip fixed to the anode, the difference representing the high-frequency energy generated. It seems, however, uncertain whether this arrangement can be used, as Riesinger claims, as a dose intensity indicator. Schwarz suggested two rapid methods: first, determination of 'spread' of the resonance curve by means of variable condenser and Braun tube; secondly, measurement of true field across the object by small electrometer electrodes mounted in the condenser plates. The papers on the subject gave the impression, however, that the problem is still far from being solved.

J. B. BATEMAN.

The Science of Archives in South Africa*

STUDY and work connected with archives have been recognized as a science, and a scientific system of keeping archives has been evolved; while not only is a high standard of attainment and a wide range of knowledge of scientific method and results demanded of the archivist, but also in certain European countries provision has been made for his technical training.

Archives constitute a fundamental source of historical information, and hence the introduction of the moving picture—the cinematograph film and the 'talkies' have, in the problem of their conservation, forced on the attention of the archivist a number of practical questions, the method of dealing with which has yet to be determined on scientific lines.

In South Africa, prior to the date of the Union, the Cape Province gave attention to this subject more than half a century ago, and the Transvaal since about 1902. In 1919 the Union Government took the first serious step in co-ordinating the archives of the four provinces.

The administration of Union and Provincial Archives was centralized in a chief archivist, and by legislation of 1922 Union and Provincial archive depots were created, the former at the seat of government of the Union, and the latter at the seat of the Provincial administration. The centres thus are in Cape Town, Pretoria, Pietermaritzburg and Bloemfontein, each in charge of an archivist, and the whole administration centralized in the chief archivist. This system secures uniformity of administration, arrangement, classification, inventorying, methods of preservation and general care. It has resulted in straightforward administrative efficiency, and experience has taught that it is the only satisfactory method. Experts in archive economy the world over endorse this system.

The Archives Department is a young branch of the Public Service of the Union of South Africa. Its advance, unspectacular but steady, during the last decade or so, was marked by a persistent claim to recognition as an integral part of the Government machinery and the necessity for its personnel to be men with a certain standard of education and an aptitude for the work.

An archives depot is not static, and must increase in quantity and quality as the years pass. The Department was conceived, no doubt, as a branch of the service with great possibilities. Its growth was slow at first, and to some extent stunted because it had to overcome many prejudices. When it was given a place in the Government machinery, it had to live down the prevalent conception that it was a warehouse for the storage of records with someone in charge to keep them from deterioration and permit their consultation when necessary. It had to have a proper home and the right kind of vitamins in its food to allow it to develop. But this stripling of a department struggled on, facing all the obstacles which beset it.

South Africa had the advantage of studying the systems of similar institutions of older and more experienced countries. It avoided the pitfalls made by them in the past and took the best from each country and adapted this to suit the conditions in South Africa. Other sections of the British Commonwealth of Nations afterwards gave attention to the organization of their national records, such as the Commonwealth of Australia and the Dominion of New Zealand. The most recent recruit is the Colony of Southern Rhodesia, which created an Archives Department by legislation a few years ago. From the three countries, inquiries came to South Africa regarding the system of keeping archives which was being adopted.

Within the last ten years, the archives at Cape Town, Pietermaritzburg and Bloemfontein have been transferred to their buildings with up-to-date equipment and protective devices at a cost of many tens of thousands of pounds. Steps are being taken to provide a separate building at Pretoria, which will house the Provincial archives and contain the records of the Union Government, when old enough for the transfer so laid down by law.

To illustrate the growth of this branch of the service during the last eighteen years, personnel and salary expenditure have increased from a staff of five and an expenditure of £2,800 in 1919, to a staff of 42 and an expenditure of £11,000 in 1937. The number of researchers and visitors and volumes consulted during the last five years indicates a steady and encouraging increase.

The system for the arrangement and classification of the archives in South Africa is that recognized in Europe, and referred to as the 'principe des fonds', in which the system of classification is based on the department of origin. Experience has shown that this is the only sound one.

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* Substance of the presidential address to the South African Association for the Advancement of Science, at the Windhoek meeting on July 5, 1937, by Lieut.-Colonel C. Graham Botha, chief archivist of the Union of South Africa.

Colonel Botha described the duties of the archivist in relation to arrangement, classification, inventory and catalogue, and touched upon the physical defence of archives, covering the repository and accommodation, and their moral defence, referring to their reception and arrangement, in which he must study the administrations concerned, their history and organization, and divide them into classes and subdivisions of these; while the secondary duty of the archivist relating to the special requirements of the student covers the preparation of guides, lists, inventories and catalogues of his archives. Full transcripts must be prepared and published under an editor to meet the needs of the student resident at a distance. He also dealt with the problem of selection and destruction.

Finally, in illustration of his contention that archives are the material of history, Colonel Botha outlined from the records preserved in the archives, the history of the national roads in South Africa, the creation of a national road fund, and the constitution of a National Road Board in 1935, of which the story is disclosed in the archives by records of South Africa's early road system and its administration from the seventeenth century onward.

In conclusion, the science of archives may be likened to a venerable sage, who seeks for the authentic traces of man and his doings in the past and, finding them, preserves and jealously guards them. His eyes are glowing with wisdom drawn from the mass of evidence of man's past accomplishments, his failures and successes, as treasured up by him with tender care; ever ready to reach a helping hand to men of the present day in their struggles to move onward the ship of human progress, often doing so with an encouraging smile and reference to the Solomon of Biblical times: "there is nothing new under the sun"; and he appeals insistently to one and all to view the present unfolding of our grand and wonderful universe in the light of the ages gone by.

Science News a Century Ago

Lyell in Germany

WRITING from Wesel on the Rhine on August 29, 1837, to Darwin, Lyell said, "I write this to you, at least I am beginning it, in a steamboat on the Rhine, so make allowance for the tremulous motion. We came in a steamer from Copenhagen to Lübeck, then in a hired carriage to Hamburgh, across the sand and boulder formation of the Baltic, which for the most part we have been on ever since, although we have crossed the Weser, and Ems, and Lippe. The blocks of red syenitic granite, which I hammered away at in Norway, and which I saw there *in situ* sending its veins into the trilobite and orthoceratite schist, have been carried with small gravel of the same, by ice of course, over the south of Norway, and thence down the south-west of Sweden, and all over Jutland and Holstein, down to the Elbe, from whence they came to the Weser, and so on to this or near this. . . .

"This then was already dry land when Holstein, and all from the Baltic as far as Osnabruck or the Teutoberger Wald hills, was submerged. At Bremen I saw Olbers, aged seventy-two, the astronomer who discovered Pallas and Vesta, and at Osnabruck and Münster I met a warm and German reception from men of whom I had never heard, who had read my paper on Sweden or something else. I mean by German, that kind of frank expression of enthusiasm for science, or of any emotion, which a well-bred Englishman tries to suppress, at least all outward expression of it, from the dread of being thought ridiculous, or of affecting to feel more than he does, or from *mauvaise honte*. If you ever get sick of that fashionable nonchalance which would blush to admire anything, or at least to confess it, I advise you to plunge into Germany, and you will be soon refreshed and brought back to the right tone again, whether it be literature, science, or any other pursuit you are following. . . ."

The First Steam Frigate

ON August 31, 1837, H.M.S. *Gorgon*, the first steam vessel in the Royal Navy designed as a frigate, was launched at Pembroke. Designed by Captain (afterwards Admiral) Sir William Symonds, the Surveyor of the Navy, the *Gorgon* was 178 ft. long, 37½ ft. beam and 1,108 tons burthen by the rule known as Builders' Old Measurement. She was noteworthy not only as being designed as a frigate, but also as being the first vessel in the Navy to be fitted with John Seaward's direct-acting engine, instead of a side-lever engine, by which a considerable saving of weight was effected. The cylinders were placed directly beneath the crankshaft driving the paddle wheels. They were 64 in. diameter with a stroke of 5½ ft., the engine being of 320 nominal horse-power. The boiler pressure was 5 lb. per square inch. The total weight of the machinery, including the water in the boilers, was 276 tons. Service in such vessels was eagerly sought after by far-sighted young naval officers, and among those who served in the *Gorgon* was Admiral Sir Astley Cooper Key, who as a lieutenant exchanged from the *Curaçoa* into the *Gorgon* and in doing so spoke of it as almost a change of profession. "Being in a steamer", he wrote, "has given me a much greater interest in the service than I had before, from having, I suppose, an object in view to which I feel myself suited." On another occasion he wrote, "I study De Pambour and Tredgold daily".

The British Association at Liverpool

IN its issue of September 2, 1837, the *Athenæum*, referring to the forthcoming meeting of the British Association at Liverpool, said that while there had been no doubt as to the really excellent fruits of the morning meetings, the same satisfaction had not been felt regarding the evening meetings, which had been intended for diffusing among the general body of members "some part of the treasures of knowledge collected and purified in each Section". There was therefore to be a change of plan. "The great want of opportunity for cultivating mutual acquaintance and enjoying friendly discussion—a desideratum felt with increased force at every Meeting succeeding the embryo sitting at York—will be met by devoting at least two evenings to a pleasurable Promenade and Conversazione in the magnificent apartments of the Town Hall, which the Mayor and Council have most liberally placed at the disposition of the Association. Thus the evenings may offer an agreeable relaxation after the morning work—the men of abstract and practical knowledge may be mingled together, and both brought into friendly intercourse with those numerous friends of the Association who attend the meetings to gather knowledge, and those whom they esteem as leaders of science."

Societies and Academies

Dublin

Royal Dublin Society, June 22.

H. G. Wager and Elizabeth M. Wager: Annual changes in the osmotic value of some arctic and temperate plants. Determinations of the osmotic value of some arctic plants were made at intervals throughout the year in Kangerdlugssuak, East Greenland, during the course of the British East Greenland Expedition, 1935–36. The changes in the osmotic value have been correlated with the climate of the district.

Margaret Mohan, J. Keane and T. J. Nolan: The chemical constituents of lichens found in Ireland: *Parmelia conspersa*, Ach. While the Japanese and European varieties of the lichen have been found to contain salazic acid, the Irish lichen, collected at Howth, Co. Dublin, has been found to contain stictic acid. All three varieties also contain usnic acid.

J. H. J. Poole: A synchronous clock time-marker. The movement of a synchronous electric clock forms a cheap and convenient motor for causing a disk with slits to rotate once per minute and thus provide a series of light-flashes at convenient intervals to form a time base on a photographic film recorder.

H. H. Poole: A convenient form of galvanometer shunt for use with rectifier photo-cells. A constant resistance shunt of the telephone attenuator type, giving ratios 1, 5, 10, 50, 100 and 500, with an external resistance 10 ohms on every range with a 10-ohm galvanometer, is very suitable for daylight measurements. The use of spring keys to bring either of two cells into circuit and then to increase the sensitivity by successively cutting out the shunts saves the sensitive galvanometer from accidental damage. A reversing key doubles the sensitivity for small deflections.

Royal Irish Academy, June 28.

K. Jessen and A. Farrington: The bogs at Ballybetagh, with remarks on the development of late-glacial deposits in Ireland. An investigation of the well-known deposits near Dublin containing remains of *Cervus giganteus*. A detailed description of the deposits is given with a list of plants identified in the late-glacial and early post-glacial beds. Pollen diagrams from several points are discussed. Comparison is made with deposits found in other basins, for example, at Ralaghan, Co. Cavan, and a general view of late-glacial conditions in Ireland is suggested.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 5; 1937).

G. Cesàro and J. Mélon: The crystalline form of aconite.

P. Gérard: The renal elimination of acid colouring matters in *Astacus fluviatilis*.

M. Kourensky: The integration of linear partial differential equations of the first order of two and more than two unknown functions.

N. Neronoff: Reduction of a plane problem in hydrodynamics to the solution of a system of functional equations (2).

S. Arend: Direct calculation of the relationships used in positional astrography.

F. E. Nisoli and J. Gérard: New determination of the vertex of the cluster in Taurus and of the star stream in Scorpius.

M. G. E. Cosyns: Variation of the specific primary ionization of hydrogen as a function of the energy of the incident electrons.

Geneva

Society of Physics and Natural History of Geneva, June 17.

G. Bilger: The potential of polygons and elementary geometry. The author demonstrates the following propositions: (1) All regular homogeneous regular polygons having the same vertices and the same mass create the same logarithmic potential of the simple layer in the connex domain of the point at infinity. (2) All homogeneous semi-regular polygons, inscribable, having the same vertices, in each vertex the same bisector and the same mass, create the same logarithmic potential of the simple layer in the connex domain of the point at infinity.

G. Carrisson: Rapid counting of a microbial suspension. The author describes a method, based on the absorption of light by the bacteria, for counting bacteria in suspension. The quantity of micro-organism in 1 c.c. can thus be determined in about ten minutes to approximately 1 in 10^6. The measurement is made with a Lange photo-electric colorimeter.

Moscow

Academy of Sciences, *C.R.*, 15, No. 2; 1937.

V. S. Ignatovskiy: The Laplacean transformation (6).

A. P. Dietzmann: The *p*-groups.

S. G. Natanson: The use of the photo-relay in the study of lunar micro-relief.

A. D. Petrov and M. A. Celčova: The catalytic isomerization of normal hexene and octene in the presence of zinc chloride and phosphoric acid.

V. A. Devyatnin and V. M. Iosikova: The determination of ascorbic acid (vitamin C) in blood and urine.

K. S. Maslov and I. A. Korobkov: Discovery in Juria of Upper Eocene characterized by its fauna.

J. A. Petrokovič: The phosphorite-bearing horizon of the Mangysplak Triassic.

F. V. Čuchrov: Antlerite of the Krestovozdvizhensk region in Djeskagan.

Y. M. Olenov, I. S. Kharmac, K. T. Galkovskaya, N. I. Kniazeva, A. D. Lebedeva and Z. T. Popova: Natural selection in wild populations of *Drosophila melanogaster*.

L. I. Džaparidze: The anatomical connexion between the acerose leaf and the pitch-carrying system of the wood in *Pinus* sp.

Rome

National Academy of the Lincei (*Atti*, 24, 393–487; 1936).

L. Tonelli: (1) Problem of Plateau (2). (2) Semi-continuity in the problems of Mayer and of Lagrange.

O. M. Corbino: Method of calibrating the electrostatic microphone based on its behaviour towards an alternating electromotive force.

C. Barba: Definite polynomials (1). Fundamental problems.

R. Caccioppoli: Branched inverted functional correspondences: general theory and applications to some non-linear functional equations and to Plateau's problem (2).

E. Levi: Characteristic properties of Laplace's transformation.

G. Arrighi: Isocarene oscillations about the configurations of general equilibrium (2).

E. Gugino: Variational problem which assumes prefixed trajectories.

C. Jacob: Bifurcation of a liquid jet due to a circular obstacle.

L. Sona: Translo-circulatory current in presence of an obstacle formed by two crossed laminæ.

G. Boaga: Localization of a spherical body by means of Eötvos measurements.

A. Baroni: Electron diffraction study of the graphitization of some industrial lamp-blacks.

A. Iandelli and E. Botti: Crystal structure of the compounds of the rare earths with the metalloids of the fifth group. Phosphides of lanthanum, cerium and praseodymium (1).

G. Natta and L. Passerini: Dimorphism of white phosphorus.

F. Rodolico: Granular forms of melilitic rocks.

G. Negodi: Further contributions to the cariology of the genus *Fumaria*.

W. Jablonski: Survival and mitosis of free epithelial cells *in vitro*.

G. Lolli: Thyroid function and experimental alcoholæmia.

E. Serianni: The action of morphine on the curve of experimental alcoholæmia in the normal man.

Sydney

Royal Society of New South Wales, June 2.

Adolph Bolliger: Compounds of creatinine with alkali hydroxides. In an alcoholic medium, creatinine forms with sodium, potassium and rubidium hydroxide, crystalline compounds which can be readily isolated and which may consist either of one molecule of creatinine, one of alkali hydroxide and one or two of water, or of one atom of alkali and two or three molecules of water.

G. F. K. Naylor: A preliminary note on the occurrence of Palæozoic strata near Taralga, N.S.W. Recent investigations near Taralga have shown that Palæozoic sedimentation is represented in that area by Upper Ordivician, Upper Silurian and Upper Devonian strata, their respective ages being determined conclusively by the presence of fossils. The general rock pattern conforms to, and is continuous with, that previously determined in the Goulburn district. An interesting point is the finding of black shale containing *Monograptus bohemicus*, interbedded with highly fossiliferous Upper Silurian limestones. This indicates that the latter are of Lower Ludlow age, and owing to the restricted range of that graptolite, may lead to a more exact correlation of N.S.W. Silurian rocks with British and Victorian occurrences than has hitherto been possible.

A. J. Birch: The detection and estimation of α-phellandrene in essential oils. This paper describes an adaptation of the 'diene' synthesis to the detection of α-phellandrene in small quantities, and its estimation in the presence of *p*-cymene, cineol, limonene or α-pinene.

Forthcoming Events

British Association for the Advancement of Science (Nottingham Meeting).

Wednesday, September 1

At 8.30 p.m.—Sir Edward Poulton, F.R.S.: "The History of Evolutionary Thought, as recorded in the Meetings of the British Association" (Presidential Address in the Albert Hall).

Thursday, September 2

At 10 a.m.—Sir William Bragg, O.M., K.B.E., Pres. R.S., Dr. G. Shearer, Dr. J. D. Bernal, F.R.S., J. T. Randall and H. P. Rooksby, Dr. A. J. Bradley, and R. M. Powell and W. A. Wood: "X-Ray Methods and Industry" (Symposium: Section A).

Dr. F. L. Pyman, F.R.S., Prof. H. Horlein, Sir Gilbert Morgan, Dr. W. Kikuth and Prof. R. Robinson, F.R.S.: "Some Aspects of Chemotherapy" (Symposium, including Dr. Pyman's Presidential Address entitled "Researches in Chemotherapy": Section B).

Prof. F. A. E. Crew: "The Sex-Ratio" (Presidential Address: Section D).

H. Wolfe, C.B., C.B.E., H. M. Hallsworth, C.B.E. Dr. O. A. Oesor and A. D. K. Owen: "Labour Transference" (Discussion: Section F).

Dr. E. P. Poulton: "Heat Production, Nutrition and Growth in Man—Some New Views" (Presidential Address: Section I).

Prof. E. J. Salisbury, F.R.S.: "The Modern Study of Plants in Relation to Education" (Presidential Address: Section K).

H. G. Wells: "The Informative Content of Education" (Presidential Address: Section L).

J. M. Caie: "State Intervention in Agriculture" (Presidential Address: Section M).

Sir Alexander Gibb, G.B.E., C.B., F.R.S.: "Research in Engineering" (Presidential Address: Section G).

Prof. D. Burns, A. L. Bacharach, Mrs. C. M. Burns, Dr. G. E. Friend, Prof. E. Atzler, Prof. S. J. Cowell: "Contribution of Physiology to the Health of the Individual and the Community" (Discussion: Section I).

At 2.15 p.m.—Prof. J. Ritchie: "The Outlook of Natural Science" (Presidential Address to the Conference of Delegates of Corresponding Societies).

Friday, September 3

At 10 a.m.—Dr. G. W. C. Kaye, O.B.E.: "Noise and the Nation" (Presidential Address: Section A).

Prof. C. R. Harington, F.R.S., Dr. K. Linderström-Lang, Dr. W. T. Astbury, Dr. D. M. Wrinch, Dr. A. Neuberger and J. St. L. Philpot: "Protein Chemistry" (Symposium: Section B).

Prof. L. J. Wills: "Pleistocene History of the West Midlands" (Presidential Address: Section C).

Dame Helen Gwynne-Vaughan, G.B.E., Prof. F. A. E. Crew, Prof. R. A. Fisher, F.R.S., Dr. F. W. Sansome, Dr. C. D. Darlington, Dr. P. C. Koller, E. B. Ford and Dr. J. S. Huxley: "Recent Work in Genetics and Cytology" (Joint Symposium: Sections D and K).

Prof. C. B. Fawcett: "The Changing Distribution of Population" (Presidential Address: Section E).

Prof. P. Sargant Florence: "Economic Research and Industrial Policy" (Presidential Address: Section F).

Prof. F. G. Baily and A. P. M. Fleming: "Training of University Graduates for the Engineering Industry" (Discussion: Section G).

Prof. J. H. Hutton, C.I.E.: "Assam Origins in Relation to Oceania" (Presidential Address: Section H).

Dr. Mary Collins: "Tests in Common Use for the Diagnosis of Colour Defect" (Presidential Address: Section J).

Prof. A. M. Carr-Saunders, Sir Frank Fletcher, Mrs. E. V. Parker, M. A. Desclos and Dr. Graefer: "Education for the Community" (Discussion: Section L).

L. Holland, J. Macdonald, J. T. Fitzherbert, Dr. S. E. Wilson, C. J. Jones: "Mining Timber" (Symposium: Section K*).

Discussion on "Anthropology and Administration" (Section H).

At 7.30 p.m.—Prof. J. Walton: "Coal and its Origin" (Popular Lecture at Mansfield).

At 8 p.m.—R. Kay Gresswell: "Rivers and Waterways" (Public Lecture at Lincoln).

At 8.30 p.m.—Dr. R. E. Slade: "Grass and the National Food Supply" (Evening Discourse).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TECHNICAL OFFICER and ASSISTANTS (grades II and III) at the Air Defence Experimental Establishment, Biggin Hill, Kent (September 1).

ASSISTANTS (grade III—electrical engineering and photographic equipment) at the Royal Aircraft Establishment, South Farnborough, Hants.—The Chief Superintendent (September 3).

RESEARCH ASSISTANT IN CHEMISTRY (radioactivity) in the University of Manchester—Prof. M. Polanyi (September 6).

DEMONSTRATOR IN HISTOLOGY AND EMBRYOLOGY in the Royal Veterinary College and Hospital, Camden Town, London, N.W.1—The Secretary (September 7).

UNIVERSITY ASSISTANT IN AGRICULTURAL BOTANY in the University of Aberdeen—The Secretary (September 14).

PROFESSOR OF BOTANY in the University College of the Orange Free State, Bloemfontein—The Rector (September 30).

EXAMINER (Chemist) in the A.I.D. Test House, Kidbrooke (Non-Metallic Material Section, Oils and Petrols Sub-Section)—The Secretary [S.2 (d)] Air Ministry, Kingsway, W.C.2 (October 31).

WATERWORKS ENGINEER for the Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote *M*/534C).

LECTURER IN GEOLOGY in the University of Rangoon—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, W.C.1.

PROFESSOR OF ANATOMY in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, W.C.1.

Official Publications Received

Great Britain and Ireland

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology, No. 10: The Effects of Light and of Oxygen on the Uptake of Sugar by the Foliage Leaf. By E. Phillis and T. G. Mason. Pp. 231–237+2 plates. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*. [48

Technical College, Bradford. Diploma and Special Day Courses, Session 1937–1938. Pp. 261+21 plates. (Bradford: Technical College.) [48

British Non-Ferrous Metals Research Association. Research Report, Association Series No. 440: The Fatigue Resistance of Lead and Lead Alloys (Summary Report). By H. Waterhouse. Pp. 8. (London: British Non-Ferrous Metals Research Association.) 2*s*. [48

I.C.I. Game Researches. Advisory Leaflet No. 12: Disease; some Simple Treatments. Pp. 10. Advisory Leaflet No. 13: Partridge Stocks and Mortalities. Pp. 10. (London: Imperial Chemical Industries, Ltd.) [58

Transactions of the Institution of Chemical Engineers. Vol. 14, 1936. Pp. iv+176. (London: Institution of Chemical Engineers.) [68

The North of Scotland College of Agriculture. Calendar, Session 1937–1938. Pp. viii+128. (Aberdeen: North of Scotland College of Agriculture.) [68

Department of Scientific and Industrial Research. Forest Products Research Records, No. 19 (Seasoning Series, No. 4): Methods of Kiln Operation. By R. G. Bateson. Pp. ii+12+4 plates. (London: H.M. Stationery Office.) 6*d*. net. [68

River Flow Records. By Capt. W. N. McClean. Series A: River Garry. Sheet No. 1. 1*s*. 6*d*. Series B: River Moriston. Sheet No. 1. 1*s*. 6*d*. Series C: River Ness. Sheets 1–14. In portfolio. 15*s*. (London: River Flow Records.) [98

British Trust for Ornithology. Third Report, Summer 1937. Pp. 38. (London: British Trust for Ornithology.) [98

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1936. Pp. iv+602+10 plates. (London: H.M. Stationery Office.) 15*s*. net. [98

Imperial Agricultural Bureaux. Herbage Publication Series, Bulletin No. 19: Production of Grass Seed: an International Exchange of Opinions and Experiences on the Technique of Producing Seed of Gramineous Herbage and Forage Plants. Edited by R. O. Whyte. Pp. 46. 5*s*. Herbage Publication Series, Bulletin No. 20: Insects and other Pests injurious to the Production of Seed in Herbage and Forage Crops. By H. F. Barnes. Pp. 31+iii. 2*s*. 6*d*. Herbage Publication Series, Bulletin No. 21: The Influence of Climatic Conditions on Type Composition. By Nils Sylvén. Pp. 8. 1*s*. (Aberystwyth: Imperial Bureau of Plant Genetics, Herbage Plants.) [118

Other Countries

Department of Public Instruction, Technical Education Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1936. Pp. 6. (Sydney: Government Printer. [48

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 16: The General Theory of the Gradient of Pressure under a Structure on Permeable Foundations, with Applications to the Evaluation of the Gradient at Exit for some Standard Cases. By Jai K. Malhotra and Dr. E. McKenzie Taylor. Pp. 10. 3 annas; 4*d*. Research Publication, Vol. 3, No. 2: The Soils of the Rice Areas of the Gujranwala and Sheikhupura Divisions of the Upper Chenab Canal. By M. L. Mehta. Pp. 25+iii+4 plates. 10 annas; 1*s*. Research Publication, Vol. 3, No. 3: A Study of the Soil Profiles of the Punjab Plains with reference to their Natural Flora. By R. C. Hoon and M. L. Mehta. Pp. 47+10 plates. 1.3 rupees; 1*s*. 10*d*. (Lahore: Punjab Irrigation Research Institute.) [48

U.S. Department of the Interior: Office of Education. Pamphlet No. 70: Per Capita Costs in City Schools, 1935–36. By Lula Mae Comstock. Pp. 24. 10 cents. Pamphlet No. 73: Subject Registrations in Private High Schools and Academies, 1932–33. Text by Carl A. Jessen; Statistical Tables by Lester B. Herlihy and Mrs. Blanche K. Choate. Pp. 30. 10 cents. (Washington, D.C.: Government Printing Office.) [48

Field Museum of Natural History. Botanical Series, Vol. 9, No. 3: Useful Plants and Drugs of Iran and Iraq. By David Hooper, with Notes by Henry Field. (Publication 387.) Pp. 69–242. 1.50 dollars. Botanical Series, Vol. 17, No. 1: The North American Species of Rumex. By K. H. Rechinger, Jr. (Publication 386.) Pp. 152. 1.50 dollars. (Chicago: Field Museum of Natural History.) [48

Proceedings of the United States National Museum. Vol. 84. No. 3020: Synopsis of the Puerto Rican Beetles of the Genus Mordellistena, with Descriptions of New Species. By Eugene Ray. Pp. 389–400. (Washington, D.C.: Government Printing Office.) [48

Smithsonian Miscellaneous Collections. Vol. 91, No. 27: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. A New Species of Deep-Sea Fish, *Argyropelecus antrorsospinus*, of the Family Sternoptichidae. By Leonard G. Schultz. (Publication 3439.) Pp. ii+6. Vol. 96, No. 3: Phototropic Response and CO_2 Assimilation of Plants in Polarized Light. By Earl S. Johnston. (Publication 3440.) Pp. ii+8. (Washington, D.C.: Government Printing Office.) [48

Carnegie Institution of Washington. Publication No. 480: Delta, Estuary and Lower Portion of the Channel of the Colorado River 1933 to 1935. By Godfrey Sykes. Pp. vi+70+6 plates. (Washington, D.C.: Government Printing Office.) 1.25 dollars. [58

International Institute of Agriculture. Studies of the Principal Agricultural Products on the World Market, No. 1: World Cotton Production and Trade. Pp. xii+462+20 plates. (Rome: International Institute of Agriculture.) 30 lire. [68

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 20, Memoir No. 6: The Mesozoic Brachiopoda of the Attock District. By Dr. Helen M. Muir-Wood. Pp. iv+34+1 plate. (Calcutta: Geological Survey of India.) 2.2 rupees; 4*s*. [98

Pasteur Institute of India, Kasauli. The Thirty-fifth Annual Report of the Director of the Institute for the Year 1935, Part 2. Pp. 49. (Kasauli: Pasteur Institute of India.) [98

Annual Report of the Imperial Council of Agricultural Research for 1936–1937. Pp. v+119. (Delhi: Manager of Publications.) 1.2 rupees; 2*s*. [98

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1936. By J. P. Mead. Pp. iii+66+5 plates. (Kuala Lumpur: Government Printer.) 1 dollar; 2*s*. 4*d*. [98

Indian Forest Records (New Series). Vol. 1, No. 5: Second Interim Report on Work under Project 8 (Testing of Indian Timbers for Veneer and Plywood). By W. Nagle. Pp. iv+115–141. 14 annas; 1*s*. 6*d*. Vol. 3, No. 1: Entomological Investigations on the Spike Disease of Sandal (31) Dermaptera and Orthoptera. By Dr. L. Chopard and N. C. Chatterjee. Pp. ii+30. 1 rupee; 1*s*. 9*d*. Vol. 3, No. 2: Immature Stages of Indian Coleoptera (21) Cleridae. By J. C. M. Gardner. Pp. 31–47+2 plates. 12 annas; 1*s*. 3*d*. (Delhi: Manager of Publications.) [98

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 8: Malayan Agricultural Statistics, 1936. By D. H. Grist. Pp. xii+91 tables. 50 cents. General Series, No. 26: Reports of the Research, Economic and Agricultural Education Branches for the Year 1936. Pp. iii+97. 50 cents. (Kuala Lumpur: Department of Agriculture.) [98

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural and Chemical Series, Bulletin No. 51: Soil and Plant Material Analyses by Rapid Chemical Methods, II. By Francis E. Hance. Pp. 135–186. (Honolulu: Hawaiian Sugar Planters' Association.) [108

Field Museum of Natural History. Botany Leaflet 21: Tea. By Llewelyn Williams. Pp. 30. (Chicago: Field Museum of Natural History.) 25 cents. [108

NATURE

No. 3540 SATURDAY, SEPTEMBER 4, 1937 Vol. 140

CONTENTS

PAGE
Processes of Organic Evolution . . . 379
Ancient Fauna and Early Man at Bethlehem . . . 381
Scientific Aspect of Chinese Glazes. By Sir Gilbert Morgan, O.B.E., F.R.S. . . . 382
The Future of Statistical Mechanics. By E. A. M. . . . 382
Plant Protection. By E. F. A. . . . 384
Gases and Metals. By N. P. A. . . . 385
Observational Evidence for the Distribution of Matter in Space. By J. H. Reynolds . . . 387
The Nutritive Value of Pasteurized Milk . . . 389
Bicentenary of Galvani . . . 391
Obituary Notice:
  Prof. D. Morgan Lewis. By T. C. J. . . . 392
News and Views . . . 393
Letters to the Editor:
  The Light thought to have been seen in the Neighbourhood of Alternate Current Magnets.—The Right Hon. Lord Rayleigh, F.R.S. . . . 423
  Cosmic Rays and Magnetic Storms.—Prof. S. Chapman, F.R.S. . . . 423
  The Cluster Theory of Imperfect Gases.—C. F. Goodeve . . . 424
  A Method of obtaining Polarized Neutron Beams.—Dr. Hans v. Halban, jun. . . . 425
  Circular Ultra-sonic Grating in Liquids.—Miss J. Čeřovská . . . 425
  Vitamin E Deficiency in the Suckling Rat.—Miss M. M. O. Barrie . . . 426
  Vitamin P.—A. Bentsáth and Prof. A. Szent-Györgyi . . . 426
  Choline Esterase Activity of Superior Cervical Ganglia.—David Glick . . . 426
  Choline Esterase in the Central Nervous System.—D. Nachmansohn . . . 427
  Specificity of the Salicylic Aldehyde Reaction of Csonka-Straub.—Prof. A. E. Braunstein . . . 427
  A Cage Colony of *Anopheles gambiæ* Giles.—Botha De Meillon . . . 428
  The Position of Genetics.—Prof. J. B. S. Haldane, F.R.S. . . . 428
Research Items . . . 429
The Bone-Bearing Beds of Bethlehem: Their Fauna and Industry. By Elinor W. Gardner and Dorothea M. A. Bate . . . 431
The Lake District as a National Park . . . 433
Science News a Century Ago . . . 434
University Events . . . 435
Societies and Academies . . . 435

BRITISH ASSOCIATION SUPPLEMENT:
  The History of Evolutionary Thought as Recorded in Meetings of the British Association. By Sir Edward Poulton, F.R.S. . . . 395
  Summaries of Addresses of Presidents of Sections . . . 408

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No. 3540 SATURDAY, SEPTEMBER 4, 1937 Vol. 140

Processes of Organic Evolution

ONE of the difficulties about organic evolution is that it has not been and probably cannot be demonstrated in a strict sense, and although the indirect lines of evidence converge with such unanimity upon the probability of the theory that the scientifically trained mind is convinced, a loophole for doubt remains to the multitudes who must rely upon the dictum of authority one way or the other.

The evolutionist who rests upon his oars, convinced that the stream is running with him, misjudges the set of at any rate one considerable part of the current. "Le problème de l'Evolution paraissait plus près de sa solution, il y a quarante ans, que maintenant", wrote Prof. Caullery, and the critical examination of "le Transformisme" is a noticeable activity of French thought at the moment. In America the anti-evolution or Fundamentalist position is well entrenched. There in June the monthly magazine *Evolution*, described as "A Journal of Nature ; For Popular Education in Natural Science, to Develop the Open Mind", reappeared after a lapse of five years due apparently to lack of supporters interested in open minds ; and the editor, after interviewing 20,000 persons, says, "I am more convinced that there is a need and a real field for *Evolution* than I was before I started." He was advised if he wished to make a commercial success of his journal to change *Evolution* to some "less offensive" name. In Great Britain the feeling against evolution lies rather under the surface, but it exists, and we recall the surprise with which we listened to the announcement of a University student that she did not propose to answer any examination question upon evolution, because neither she nor her parents believed in it !

When, therefore, Sir Edward Poulton in the course of his charmingly reminiscent presidential address to the British Association on "The History of Evolutionary Thought, as recorded in Meetings of the British Association", which is printed in the Supplement to this issue of NATURE, passed lightly over "the subject of organic evolution itself, *as generally accepted*" (our italics), he spoke truly of his scientifically minded audience, for he recalled only one example of opposition to a belief in organic evolution, and that was at the first meeting he attended, in 1881. But the swamping of two thousand scientific workers by a week-end influx of trippers during the Blackpool meeting gave perhaps a rough indication of the number of believers to the masses who do not understand evolution, who do not care, or who are actively or passively opposed. The position, however, is gradually changing. The idea of evolution, as understood to-day, is comparatively new, and the natural death of prejudice, together with the diffusion of knowledge in school and college, and particularly through the far-reaching voice of the radio, are paving the way for the general recognition of a process the idea of which has become a commonplace of scientific thought.

Evolution rests upon two primary or basic factors : the vital characteristic of organisms to produce variations, and the heredity which makes possible the establishment or perpetuation of these variations. Both aspects have been discussed at meetings of the British Association, but the tendency has been for debate to centre upon the secondary or guiding factors, the means by which the course of evolution has been directed. Here there has been controversy enough since natural selection took the field, and particularly since that discussion in 1887 at Manchester upon "The Hereditary Transmission of Acquired Characters" in which Weismann took part, who all but strangled the idea of the inheritance of acquired characters at its resuscitation.

Into this controversy, Sir Edward Poulton in his address threw himself with gusto and with many recollections of the great debaters of the past, for he himself during the last fifty years has been in the forefront of the battle. Having nailed his colours to the mast, he picked here and there from the meetings of the last half-century opinions or evidences in favour of the efficacy of natural selection, notably from Prof. Alfred Newton and Canon Tristram, and against the inheritance of acquired characters by Ray Lankester.

The recalling of these contentions is a reminder of the difficulty of adducing real proof of any theory of evolutionism, and of the assumptions which the early followers of Darwin permitted themselves. Take the quoted case of Canon Tristram's larks of North Africa, where a sandy area has a long-billed, and a rocky district a short-billed species. The assumption made was that "the shorter-billed birds would be at a disadvantage in obtaining food from sandy areas but at an advantage among the rocks where strength is required". A plausible assumption, but, unbacked by a thorough analysis of the food consumed and the food available, no more than an assumption.

Compare Tristram's evidence with the more complete observation of bill structure made by Joseph Grinnell in Lower California, where in a peculiar area of meagre rainfall and high atmospheric humidity (a humid desert) he found that lesser size of bill was a common feature of birds as different as flycatchers, finches and woodpeckers. It is difficult, but not impossible, to assume that birds of feeding habits so diverse could all benefit by exactly the same kind of modification, so that, for each, environment should select similar variations. It is even more difficult to make the assumption, since other common modifications occur in all these birds, such as deeper coloration and certain proportions of wing and tail. What seems to be clear is that environment has been at work, and has induced the living organism to respond in similar manner, no matter that the stocks were of different pedigree. But does that imply the inheritance of acquired characters? Even here more evidence about food and habits is necessary before any valid conclusion can be drawn

So it is, unfortunately, with most of the observations adduced in support of particular means of evolutionary progress. Sir Edward Poulton mentioned the work of Weldon and Thompson on the influence of impurities in the sea at Plymouth upon the frontal width of the common shore crab, which, it was suggested, ensured that the water flowing over the respiratory surface was more efficiently filtered. But these observations and experiments, beautifully convincing as they appear to be at first sight, have been criticized so reasonably and ably that the conclusions cannot be accepted with any confidence.

The fact of the matter is that the story of evolutionary thought shows, as regards the processes of evolution, that the first flush of enthusiasm, with its easy evidences and somewhat uncritical observations, has passed, and that science will be satisfied only with careful records or controlled experiments safeguarded so as to convince the open but critical mind. To this new evidence the naturalist, as well as the experimenter, must make his contribution; but for the naturalist also the conditions become more stringent, and, to take another example, the statistical analysis in relation to protective patterns of food taken by a bat will be regarded as valid only when viewed in relation to the abundance of the food items and their availability at the time and place of the bat's collecting; and that is no simple series of observations.

In another way, investigation into the modes of evolutionary progress is likely to undergo modification. Few biologists, nowadays, doubt that natural selection has played a great part in guiding that progress; it is taken to be, as Bateson took it, self-evident. But natural selection merely plays with variations created by the organism; the vital problem lies deeper. Does the vitality of the organism, a thing of wondrous properties, really express itself in non-significant variations left entirely for Nature to carve into line, or does it respond more directly to the environment in such a way that subsequent generations share in the response, or does it even more directly handle its own fate by striking out in determinate lines of its own—it being postulated, of course, that whatever the source of the variations they must afterwards come under the pruning hook of natural selection? There seem to lie the evolutionary problems of the immediate future for the eager student of biology.

Ancient Fauna and Early Man at Bethlehem

THE report on the bone-bearing beds of Bethlehem by Miss E. W. Gardner and Miss D. M. A. Bate, appearing in this issue of NATURE (see p. 431), summarizes the results of three years' excavation on a site situated in the highest part of Bethlehem on the highest point of the Judean arch, of which the importance for the physiography and palæontology of Palestine was established in 1934 by the discovery of the fossil remains of an elephant, the first evidence of the former existence of this extinct species in this geographical region.

Since that date, as Miss Bate shows, the Bethlehem bone beds have yielded evidence of an extinct fossil fauna, which is not only almost entirely new to Palestine, but is also of earlier geological age than any found there hitherto. Further, from the gravels of these deposits have come 'flints', which may prove to be the earliest trace of man in Palestine.

The character of the geological deposits in which the fossil fauna occurs, as is indicated in Miss Gardner's report, is such as to add considerably to the importance of the discovery. The bones were found in water-borne gravels deposited on a cemented scree, or breccia, weathered subaerially. The lie of the deposits is such that it is evident that they cannot have been laid down originally in the position in which they are now found. While Miss Gardner exercises a wise discretion in refraining from any premature conjecture as to their origin before excavation is complete, she goes so far as to suggest that the condition of the deposits may be due either to the collapse of the original floor or to the filling of a funnel-shaped hole. These conditions are of prime importance in pointing to movement and physiographic changes, indicating a considerable antiquity.

While the evidence of geology, pending further investigation, is thus reticent as to questions of origin and chronology, the aid of other branches of investigation—archæology and palæontology—is invoked to give evidence on the question of dating; and here is brought forward what to many certainly will seem the most startling evidence from this investigation. Miss G. Caton-Thompson, whose experience in dealing with early Stone Age forms in the East entitles her to speak with authority, has found in the vast multiform assemblage of cherts in the gravels, showing evidence of subjection to a variety of forces, a number of pieces which she holds it difficult to explain except as humanly fashioned tools. Drawing a pregnant comparison with Mr. Reid Moir's 'artefacts' from the Red Crag of Foxhall and the sub-Crag detritus bed flints of Bramhall, she regards many of the Bethlehem 'artefacts' as conforming closely "in shape and edge trimming to the classic type of Harrisonian eolith". She goes on to point out that this is the first time such evidence has been found in a sealed deposit in Palestine—evidence which "is less easy reasonably to explain as the accidental work of natural forces, than as the deliberate experimental work of man in remote pre-Chellean times".

The archæological evidence, thus possibly the earliest indication of man's appearance in Palestine, gains in significance when brought into relation with the interpretation of the palæontological data, as regards geographical distribution and dating.

The crucial point is the occurrence of the diminutive form of horse, *Hipparion*, previously known from various deposits in Asia of Tertiary age, but recently reported from the Pleistocene of India, and now well known from the Pleistocene deposits of East Africa. With it goes the evidence of other members of the Bethlehem fauna, also pointing to an affinity with Asiatic forms of like age. Miss Bate, therefore, in summing up, concludes by suggesting that the Bethlehem fauna in origin is Asiatic and that its age is not later than early Pleistocene, adding that it provides a faunistic link for this period between Asia and East Africa.

It need scarcely be said that if Miss Caton-Thompson's tentative acceptance of the specimens she has selected as artefacts is well grounded, this discovery at Bethlehem will prove of transcendent importance in the consideration of the problem of the distribution of early man. It would be premature to enlarge on this aspect before the specimens have received further expert consideration; but it may be pointed out that these excavations serve to reassert the growing importance of Palestine for the problems of early man, already demonstrated in Miss Garrod's excavations and the investigations of Sir Arthur Keith and Mr. T. McCown on the physical characters of the early forms of man from Mount Carmel.

Scientific Aspect of Chinese Glazes

Chinese Ceramic Glazes
By A. L. Hetherington. (Courtauld Institute of Art.) Pp. x + 76 + 14 plates. (Cambridge: At the University Press, 1937.) 10*s*. 6*d*. net.

THIS concise and simply written treatise, which embodies an amplification of a series of lectures given recently by the author at the Courtauld Institute of Art, links together scientific facts and archæological knowledge concerning the chief glaze effects produced by Chinese potters during a period extending over some two thousand years.

A preliminary chapter is devoted to general considerations on the nature of the glazes, slips and earthenware bodies employed by successive generations of Chinese potters, on the effect of oxidation and reduction upon the colouring materials used in glazes, and on the modifications produced in these colour effects by the relative proportions of acidic and alkaline constituents in a glaze.

It is a striking testimony to the long-sustained art of the Chinese potter that nearly all his earlier colour effects were achieved by the use of only two metals, iron and copper. The old and fascinating 'iron' story, well exemplified by the ceramic ware shown at the Chinese Exhibition in London of 1935, explains the great variety of colour tints induced in glazes by varying amounts of the three iron oxides. Temperature conditions of firing and the presence of alkalis affect the final colour very appreciably. The pale blue ferrous oxide glaze of certain translucent porcelains dating from Sung times, on spectroscopic examination in the electric arc has shown persistent evidence of the lithium spectrum, a fact which points to the presence of lithia-mica in the original felspathic glaze (Chinese petuntse).

The range of colour produced by ferric oxide is even more extensive than of ferrous oxide, and, as the author has shown experimentally with boric acid and alkali borates, is greatly affected by the acidity or alkalinity of the glaze constituents.

The 'copper' story is equally remarkable, for the colour effects produced by cupric oxide and its reduction product, colloidal copper, are of the highest artistic merit. The author discusses in detail the scientific principles underlying the production of sang-de-bœuf, chün-yao, flambé and peach-bloom glazes, this section being illustrated by several coloured plates.

Under the heading of other glaze effects, a section is devoted to the use of cobalt, manganese and gold. The first two metals are utilized as colouring materials in the form of their oxides; whereas the *famille rose* wares owe their characteristic tints to the use of minute amounts of colloidal gold. This chapter contains also references to opalescence and to crackle, the latter effect being a special and popular feature of Chinese porcelain, which often develops on ageing a delayed crazing or double crackle.

This book, which contains fourteen plates, concludes appropriately with an informative glossary of Chinese and other technical ceramic terms. A selected bibliography is also included of works on Chinese ceramics, among which are to be noted two earlier publications by Mr. Hetherington on the porcelain factories and ceramic wares of China. To these authoritative treatises the present book forms a useful complementary volume.

G. T. MORGAN.

The Future of Statistical Mechanics

Statistical Mechanics:
the Theory of the Properties of Matter in Equilibrium. By Prof. R. H. Fowler. Second edition, revised and enlarged. Pp. x + 864. (Cambridge: At the University Press, 1936.) 50*s*. net.

PROF. R. H. FOWLER'S monumental work on statistical mechanics has, in this the second edition, in his own modest words, been rearranged and brought more up to date. But the new volume is much more than a revision, in that it is explicitly based on quantum mechanics from the outset; the first dynamical equation found written in the formal presentation is a wave-equation. Prof. Fowler states in justification that although classical mechanics is used to derive the quantum mechanics by a process of generalization, "once the laws of quantum mechanics have been thus guessed, as they must be before we can discuss the theorems of statistical mechanics, quantized systems naturally come first. In 1935 this attitude hardly needs apology". In consequence of this, the concluding chapter of the first edition, dealing with quantum statistics, has been incorporated in the new exposition from the start, and what is effectively the opening chapter is now doubled in length. Otherwise there is no change of general structure. But a comparison of the two editions shows that the chapter of the first edition entitled "Thermionics" is now more than four times as long, and contains a treatment of the electron theory of metals and of semi-conductors; that the chapter on dielectrics and magnetic constants has been similarly extended, and now includes an account of ferro-magnetism; lastly, there is a new concluding chapter on "co-operative" and other phenomena. The number of references is almost doubled. It is difficult to over-estimate the amount of work involved in thus re-writing and extending what was already an encyclopædic work.

The fascinating introductory chapters raise a number of interesting questions in the mind of the reader. One is that of the physical origin of the extreme generality of statistical mechanics. It is a logical structure, based on certain laws of quantum dynamics which are themselves inductions from certain special sets of phenomena; but, as Prof. Fowler remarks, the structure is "not visibly constructed to fit the facts", that is, the facts concerning phenomena in the domain of large numbers of interacting systems. "Results have been at each stage deduced from the general theory, and checked by comparison with experiment". But the comparisons with experiment are far more than a checking of the results. The comparisons with macroscopic thermodynamics do more than test the formulæ derived: they permit the *identification* of symbols introduced abstractly, as part of the mathematical apparatus, with entities known physically in a different guise. One example is the identification of the abstract symbol ϑ with the factor $e^{-1/kT}$, where kT is known physically from the more concrete dynamical theory of gases; a second is the identification of a symbol with the thermodynamic entropy; a third is the identification of a set of symbols with the thermodynamic partial potentials. The structure exists independently of these identifications: the identifications permit us to recognize the correspondence of the abstract scheme with Nature. Some of Gibbs's theorems in pure thermodynamics were known as logically unexceptionable results before the corresponding phenomena were fully studied. How comes it that statistical mechanics is in an even more powerful position?

It is impossible to answer such a question in a review. But it may be recalled that a necessary, if not a sufficient, condition that a logically correct structure shall 'correspond' with Nature is that it shall also be epistemologically correct. There must exist some ground for our direct acquaintance with the entities introduced, in the sense used in the theory of knowledge. In some way, statistical mechanics must be, also, epistemologically 'sound'. Yet in the first dynamical equation used by Fowler, already mentioned, there occurs the symbol ψ, whose epistemological status is, to say the least, doubtful. This dynamical equation of motion is, however, preceded by a dynamical *statement*, concerning the structure of a Hamiltonian, based on classical mechanics, all the terms in which are assumed directly knowable by observation. The Hamiltonian, in this case that for an ideal linear oscillator, is the *definition* of an oscillator as required for the purposes of the theory. In other words, we make clear to the reader what we are talking about by tacitly supposing a correspondence between the crude physical picture of an oscillator and the terms in a mathematical expression. Out of such axiomatic definitions mathematical physics arises, but here there is a jump from the axiomatic definition to the associated wave-equation. In cruder forms statistical mechanics existed before wave-mechanics was known, though it still had to make certain appeals to a quantum theory. There would seem possibly to be scope for a treatment which is confined to the properties of assemblies of large numbers of systems and originates from axiomatic definitions concerning such alone.

Prof. Fowler mentions the well-known consideration that the fact that a particular mechanism leads to a state of complete equilibrium in agreement with experimental facts is no evidence for the particular mechanism discussed. It is merely evidence that the laws of the mechanism have been correctly and consistently written down. It follows that there *are* certain restrictions on the laws of the mechanism, for they might have been incorrectly written down. An example of such a restriction is the principle of detailed balancing. It would be interesting to know the complete set of restrictions which statistical mechanics imposes. Are they merely that the mechanism must obey the laws of dynamics assumed as a basis for statistical mechanics? If not, how much less restrictive a dynamics is all that is necessary?

Prof. Fowler takes a somewhat pessimistic view of the future of statistical mechanics when he writes that "developments in the near future seem likely to consist mainly of applications to more and more complicated models . . . designed to account for more and more subtle properties of matter in equilibrium". Two possible lines of development offer themselves, both suggested by remarks of the author himself. One is in the statistical mechanics of non-enclosed assemblies. Prof. Fowler writes: "All assemblies whose equilibrium states can be discussed are necessarily *enclosed* assemblies. An unenclosed assembly to which all space is accessible does not in general possess an equilibrium state about which anything significant can be said". But is this true ? It would be highly interesting to obtain theorems of statistical mechanics valid in an unenclosed finite space or in an expanding sphere of inaccessible boundary. The latter case would have the added charm that the number of systems that it would be necessary to consider would be truly infinite and not merely 'large'.

Again, the part of an assembly which for the greater part of time has practically an independent existence is called a *system*, and statistical mechanics is in part the study of the equilibrium states of assemblies of such quasi-independent systems. But the dynamics of a system, still more of an assembly, seems to be an aspect of the relation of such an assembly or system to the rest of the matter in the universe ; the laws of dynamics are derivable from a study of such relationships. If so, in what sense are the systems 'independent' ? They are formally independent *given the laws*, but not independent when the dynamical laws themselves are subject to examination. This gives one an uneasy feeling that the present status of statistical mechanics is uncertain, and that a thorough-going treatment would indeed contemplate at one blow the interactions of *all* the particles in the universe. Is it not possible that some features of the distribution of spiral nebulæ in the whole universe, their mean separations, masses and proper motions, could be studied by the methods of statistical mechanics ?

The other line of development is the problem of steady states which are not equilibrium states. Consider, for example, the one-dimensional flow of heat through a gaseous assembly maintained in a steady non-isothermal state by the imposition of plane boundaries kept at given unequal temperatures. The gas must settle down into a steady state of maximum entropy subject to the given boundary conditions. Such a non-equilibrium steady-state is composed of independent systems interchanging energy, and indeed handing on energy across each plane section at the same rate. If, therefore, the boundary conditions of given temperatures could be stated in molecular language, the whole problem could be treated as a maximum or average problem by the usual methods of statistical mechanics. The trouble comes in in the precise formulation of the boundary conditions at the two ends in kinetic language when they are merely given in thermodynamic language. Since we know that the whole phenomenon is a 'transport' phenomenon, involving the sizes or free paths of the systems, we cannot hope to solve the problem without some discussion of mechanism. But the mechanism that is relevant is surely mainly the mechanism of transfer at the two end-boundaries, and it is just because the problem suggests the hope of a statistical calculation throwing light on mechanism that this problem is so attractive. I believe the problem to be in fact tractable.

E. A. M.

Plant Protection

The Scientific Principles of Plant Protection : with Special Reference to Chemical Control. By Dr. Hubert Martin. Pp. xii + 379. (London : Edward Arnold and Co., 1936.) 21*s.* net.

IN these days of selected races, artificial fertilizers and other specialized conditions, plants are proving alarmingly susceptible to attack, and there has in consequence grown up a technique regarding their protection and a science to correspond where mycologist and entomologist, chemist and physicist, meet on equal ground. 'Plant doctors' abound and there are numerous remedies varying from the spraying with copper preparations, which make the vineyards of the Rhine look so unnatural, to the use of other and beneficial insects to control the malevolent. The late Prof. H. E. Armstrong pictured for us the golfer salting his way over the greens with copper arsenate followed by the bodies of earthworms. Like Sir Albert Howard, he preached the supreme value of good nutrition based on an organic compost and believed that the outbreaks of disease are due to lack of organic manure ; that, in short, properly fed plants, like properly fed animals, would be largely resistant to disease and the road to health is through organic protective foods.

Evidence is accumulating in favour of this view and it is one which plant growers cannot afford to neglect in the future. In the meantime, farmer, fruitgrower and gardener have to face the ravages of blights and pests on their new varieties of plants, due in part to the fact that massing favours the spreading of chance infection : it is a fact that the more intensive the cultivation the greater the risks. Most of these were practically unknown a few years ago and so there has been an urge to find remedies to combat them. Dr. H. Martin, of Long Ashton, one of the most active and successful horticultural research stations, has long been regarded as an expert on the subject and the present book is a second edition, though since it has been rewritten and reset, since every phase of the subject has developed during the intervening eight-year period, it may virtually be regarded as a new book.

It is a well-balanced production with the material arranged in logical order—plant resistance is in the foreground, the factors which make plants susceptible come next and then follow several chapters on biological control, fungicides and insecticides ; weed killers, fumigants, seed and soil killers, complete the list, though Dr. Martin has also something to say about traps.

A goodly list of chemicals is paraded before our eyes, as numerous as the nostrums in the druggist's shop, and it is no wonder, in the words of Sir Daniel Hall, that "great commercial firms have embarked upon the manufacture of suitable materials for sprays and washes and have themselves promoted investigation in their desire to produce useful remedial preparations".

At the foot of the plants is the soil, which receives more than its share of the remedies, with an effect on its own fauna and flora which can only be imagined. The worms certainly object, but to-day Darwin's famous book on earthworms is out of date, and probably green-keepers do not read it.

The fact that the other side of the picture has been emphasized here must in no way be allowed to detract from the excellence of Dr. Martin's book or the economic importance of the application of the methods he describes. E. F. A.

Gases and Metals

Gases and Metals:
an Introduction to the Study of Gas-Metal Equilibria. By Dr. Colin J. Smithells. Pp. vii + 218 + 4 plates. (London: Chapman and Hall, Ltd., 1937.) 18*s*. net.

THE behaviour of metals towards the common gases is important to many industries, but investigators who have been concerned with its various aspects have had little contact with each other, and the subject has not hitherto been adequately treated from a theoretical point of view. Dr. Smithells's book is therefore extremely welcome, and its wide scope and original outlook make it a most valuable addition to metallurgical literature.

The work is divided into three chapters, which deal respectively with the adsorption of gases on the surface of metals, the diffusion of gases through metals, and their solution in metals. In each chapter there is a short general introduction and a brief description of the experimental methods, followed by a comprehensive survey of the most reliable results. No emphasis is placed on technical considerations, the data being discussed with the single purpose of defining the general laws which are obeyed, with the view of gaining an insight into the physical nature of the processes.

A sharp distinction is made between physical adsorption, which depends on van der Waals's forces alone, and activated adsorption, in which binding forces of a stronger nature are involved. Much importance is attached to the observation that only those gases which undergo activated adsorption by a given metal can dissolve in and diffuse through it, from which it is concluded that activated adsorption is a necessary preliminary to diffusion and solution, and that for all these processes some degree of chemical affinity between the gas and the metal is necessary. This thesis is elaborated in the second chapter, which contains the results of the author's and Ransley's work on diffusion, and is the most vigorous and satisfying part of the book.

In the section dealing with solution, ample recognition is given to the work of Sieverts and his collaborators, and the absorption of hydrogen by palladium, which bulks so disproportionately in the literature, is relegated to its proper place as a somewhat unusual borderline case.

This chapter contains a most valuable collection of data, but more is known of the relations between compound gases and metals than appears in this account, and the ferrous metallurgist, in particular, will feel that the equilibria which control the refining of molten steel, and its carburization or decarburization in the solid state, have received less attention than they deserve. Yet in the present state of knowledge, these relations could not have been described in the comprehensive style accorded to the rest of the book. If the metallurgist finds that reactions between compound gases and metals have not been considered as fully as their practical importance would lead him to expect, the omission will come as a salutary reminder that the experimental work which would render a satisfactory treatment possible has, for the most part, not yet been done.

N. P. A.

La civilisation Aïnou et les cultures arctiques

Par Prof. George Montandon. (Bibliothèque scientifique.) Pp. 272+48 plates. (Paris: Payot et Cie., 1937.) 40 francs.

PROF. MONTANDON visited the Ainu of Yezo, or Hokkaïdo as the Japanese now term it, in 1919. On his return he brought back a great stock of observations and an ethnographical collection, now housed in the Trocadéro in Paris, which one of the foremost authorities on the Ainu at that time pronounced to be the most complete that had ever left the island. In publishing the results of his observations in a volume which appeared not long after, Prof. Montandon promised that a more extended study of Ainu civilization would follow. This promise is fulfilled in the present volume, in which the author has reviewed and analysed critically in the light of his own observation all the information available relating to the culture of this primitive and isolated outpost of the white race.

The study falls into two parts. In the first part, Ainu civilization is described in detail as a unitary manifestation of cultural development. In the second part it is brought into relation with the cultures of the various peoples of northern Asia—Yakut, Yukagir, Gilyak, Eskimo, etc.—and as a result of an analysis of the distribution of cultural traits, an attempt is made to arrive at an estimate of the character of the original Ainu culture. As might be expected, Prof. Montandon's conclusion is that everything in Ainu civilization which can be assigned to an Ainu origin is of extremely primitive character, and belongs to the stage of the food-gatherer and the primitive hunter and fisher. All else is of extraneous origin; this, perhaps, might throw light on the remarkable distribution of the Ainu blood groups, which in its combination of mixed characters Prof. Montandon finds disconcerting.

Prof. Montandon's work is a valuable contribution to the critical literature of ethnology, as well as a welcome survey and record of a civilization which in recent years has suffered much change.

The Development of Modern Medicine:

an Interpretation of the Social and Scientific Factors Involved. By Prof. R. H. Shryock. Pp. xv+442+8 plates. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1936.) 18*s*. net.

THE object of this fascinating work, the author of which is professor of history at Duke University (Carolina), is to portray certain major aspects of medical development against a background of intellectual and social history in general from the commencement of the seventeenth century down to the present time. In the eighteenth century it is shown that physic at first did not keep pace with physics, and it was not until the latter part of this century and the beginning of the nineteenth that medicine began to make further progress. An important step in advance was the successful attempt to correlate clinical and post-mortem observations, in which Boerhaave, Haller and most of all Morgagni were pioneers. The second half of the eighteenth century was notable for contributions made to public health, such as the establishment of hospitals and dispensaries, child welfare, the control of drunkenness, work on naval and military hygiene, vaccination and other sanitary reforms.

Among the more important advances in modern times stress is laid on the collection of statistics, the influence of French medicine in Europe and the United States, medicine in Germany, preventive medicine and the economic aspects of medical practice.

Materie und Strahlung (Korpuskel und Feld)

Von Prof. Dr. Ludwig Hopf. (Verständliche Wissenschaft, Band 30.) Pp. viii+162. (Berlin: Julius Springer, 1936.) 4.80 gold marks.

IN some respects, this is a remarkable little book. The preface warns the reader that it is more difficult to present a tolerable account of modern physics without mathematics than with them: furthermore, he must not expect easy going. The theme throughout is the 'field' and corpuscular aspects of matter, and, very properly, this leads up to a climax in the more recent attempts at a synthesis by Heisenberg, and by those concerned with electron waves.

The author's treatment is naturally at its best in the earlier chapters dealing with classical physics. Here, the use which is made of diagrammatic representation appears to great advantage, especially for the gas laws, Brownian movement and electromagnetism. In quantum physics and wave mechanics, wherein direct appeal to the eye is scarcely possible, the method is perhaps not quite so happy, since the writer depends to a great extent upon direct illustration.

The philosophical outlook is characteristic and stimulating; it is woven into the fabric of the book with considerable skill. Altogether, this is a type of contribution to the literature of physics seldom seen in Great Britain, and on that account alone well worthy of careful study. F. I. G. R.

Die medizinisch-naturphilosophischen Aphorismen und Kommentare des Magister Urso Salernitanus

Nach Handschriften Lateinisch und Deutsch herausgegeben von Rudolf Creutz. (Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin, Band 5, Heft 1.) Pp. 192. (Berlin: Julius Springer, 1936.) 26.60 gold marks.

IN addition to an introduction by Dr. Paul Diepgen, professor of the history of medicine in the University of Berlin, this volume contains the aphorisms on medicine and natural philosophy of the thirteenth century physician and ecclesiastic Urso of Salerno, otherwise known as Magister Orso, followed by his commentaries in the Latin text. Dr. Rudolf Creutz has provided a full German translation of the aphorisms and an abbreviated translation of the commentaries. The historical significance of Urso, as Prof. Diepgen points out, lies in the fact that he deals with the same problems as Arnold of Villanova in the fourteenth, and Paracelsus in the sixteenth, centuries. All three writers were penetrated with Platonic and neo-Platonic ideas and reconciled their religious views with their outlook on natural science.

Observational Evidence for the Distribution of Matter in Space

By J. H. Reynolds

IT *is often* found *necessary* by *mathematical* physicists to make some generalized assumption which in detail is obviously not in accord with experience and observation. This procedure is, of course, quite legitimate, and much important work has been done with such an assumption implicit throughout ; and so long as it is recognized that it is still no more than this when the mathematical work is done, no exception can be taken. But when a mathematical assumption is brought down from its idealized condition to a pedestrian 'fact of observation', it is time for the 'fact of observation' to be put through its paces.

Such has happened quite recently in the columns of NATURE to the assumption that matter is *uniformly distributed throughout space*. It is a very desirable condition for the mathematical physicist to postulate, as it is impossible to work with an irregular distribution ; and within the limits mentioned, it has been made the basis of some very interesting and far-reaching researches. But it is now stated that it is an observed 'fact', based on the equable distribution of the 'spiral' nebulæ in space, and it is this statement which requires verification.

Fortunately, the observational material which is now available is sufficiently complete and homogeneous for us to form definite conclusions as to the spatial distribution of the spiral nebulæ, and those of the same class which show no spiral form and are known as elliptical and irregular nebulæ. This observational material, however, is limited to something over a thousand objects, and comes to an end at some distance roughly corresponding to 13 × 10^6 light years. Beyond this limit it is neither complete nor homogeneous, and it has only been possible to investigate selected regions photographed with the great American reflectors.

There are two criteria which can be adopted for estimating the distances of the nearer extragalactic nebulæ—the angular diameters and the integrated magnitude of luminosity. Both are subject to a considerable degree of uncertainty, for there is known to be a large spread in linear dimensions and in integrated brightness. This is apparent in the nearest two spiral systems, the Andromeda Nebula and *M*33. The first is condensed into stars in the outer regions with a patchy background of hazy nebulosity, the inner parts consisting of bright nebulosity increasing greatly in luminosity to a star-like central nucleus. The diameter of the major axis of the apparent ellipse on reflector plates is 160′. *M*33, on the other hand, is much more stellar in general composition and only the central regions are nebulous, with little increase of brightness in the nucleus. The major axis is 65′ on reflector plates. (The angular dimensions are those measured visually on negatives exposed in large reflecting telescopes. It has been found that these dimensions are considerably increased if recording microphotometers are used. The excess usually consists of very faint and featureless nebulosity.)

From the criterion of the Cepheid variables found in the outer regions, the distances of both can be estimated with reasonable certainty at between 700,000 and 800,000 light years (about 240 kiloparsecs) in each case, although the diameter of the Andromeda Nebula is two and a half times that of *M*33.

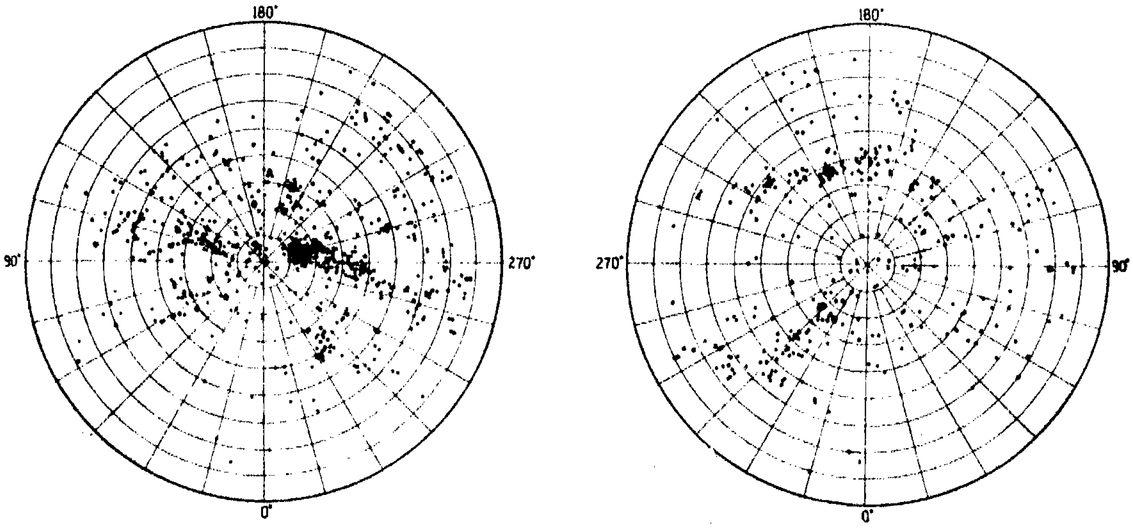
The difference between the integrated magnitudes of the two systems is still more striking. According to a list of extra-galactic nebulæ by Shapley and Ames (*Harvard Coll. Ann.*, **88**, No. 2), the integrated magnitude of the Andromeda Nebula (*M*31) is about 5, *M*33 being 8. The ratio between one magnitude and the next being 2·512, *M*31 as a whole is sixteen times as bright as *M*33. But even this relative luminosity seems to be an understatement, for in a recent paper by Redman and Shirley (*Mon. Not. Roy. Ast. Soc.*, **97**, 416) the integrated luminosity of *M*31 is given as 3·5 mag. (photographic), while the surface brightness at the centre is at least 14·8 mag. per square second of arc, compared with the fainter 20·3 mag. per square second of arc at the centre of *M*33. The dispersion in absolute magnitude can therefore be much greater than the dispersion in linear dimensions, judging from these two systems at about the same distance. For this reason I have preferred the criterion of angular diameter in my work on the spatial galactic distribution of the nearer systems.

In this kind of research there can only be one division of the celestial sphere which is fundamental, namely, that in which the great circle of the galaxy forms the equator, and all investigations into the distribution of the extragalactic nebulæ have been based on this. Let us take first of all the extragalactic systems which lie within a radius of 700 kiloparsecs (2·275 × 10^6 light years).

If we include the two Magellanic Clouds and the irregular nebula N.G.C. 6822, we find within this radius nine systems are in the south galactic hemisphere against four in the north. This result is based on Cepheid variables in the nearer objects and the detection in the more distant nebulæ of faint stars which Hubble assumes cannot exceed −6 absolute magnitude: in the case of N.G.C. 55, 247 and 300, photographed at the Helwân Observatory, Egypt, the distances are based on large angular diameters only. Seven of the nine southern systems are also probably nearer the galactic system than any of the four northern objects.

Past a radius of 1,000 kiloparsecs ($3{\cdot}25 \times 10^6$ light years) the large preponderance of systems passes to the north galactic hemisphere. They are now so far distant that no stars can be detected even with the 100-inch reflector at Mt. Wilson; the criterion of integrated luminosity has therefore been adopted both in Hubble's work and in Shapley's investigations at the Harvard College Observatory. The luminosity ratio between one magnitude and the next being 2·512; this represents a difference in distance of 1·585 per magnitude.

It is to Shapley and Ames that we owe the most complete and reliable evidence as to the galactic distribution. The whole sky was photographed with two 2-inch lenses at centres regularly spaced, the scale of the plates being 10 minutes of arc to the millimetre, and the magnitude limit for 90 minutes exposure lying between 13·5 and 14·0. The small scale brought the linear size of the nebulæ on the plate down to something near that of star disks, which could be directly compared with stars of known magnitude. It was assumed that the plates gave essentially complete information as to the nebulæ brighter than 13·2 magnitude, and this information was comprised in a detailed catalogue of 1,249 objects. It was further assumed that all these were included within a radius of 3,000 kiloparsecs; this estimate was based on integrated magnitudes alone, but if recorded angular diameters of the spiral class are taken as a criterion of distance instead, it would appear that this estimate would have to be increased to at least 4,000 kiloparsecs.


N. Galactic Hemisphere.

S. Galactic Hemisphere.

Fig. 1.

Distribution of the brighter extra-galactic nebulæ in the north and south galactic hemispheres. Open circles represent the 291 nebulæ brighter than photographic mag. 12; dots represent the 734 nebulæ of photographic magnitude 12–13. From *Harvard College Annals*, **88**, No. 2 (1932).

The plates included those nebulæ of large angular diameter above 10′ which lie within 1,000 kiloparsecs and have already been dealt with, and when all the nebulæ brighter than mag. 13 were plotted in the two galactic hemispheres it was found that those in the northern hemisphere were just about double the number of those in the southern. Not only so, but also the effect of longitude found in previous investigations without such complete information was fully confirmed. The diagram here reproduced (Fig. 1) is from Shapley's paper, and includes 1,025 nebulæ down to mag. 13.

The great condensation in and towards the Virgo region between galactic longitudes 250° and 270° and its prolongation beyond the north galactic pole has been known for many years, and the irregularities in the south galactic hemisphere are also marked. The lack of extragalactic systems within 10° of the galactic equator in both hemispheres is well accounted for by the known existence of vast clouds of obscuring matter in the galaxy. This corresponds to the 'belt of avoidance', the limits of which have been investigated by Hubble over three quarters of the great circle. In some parts the limits of the 'belt of avoidance' approach within a few degrees of the great circle, and faint small nebulæ have been photographed in these regions: in other longitudes the limits reach much farther away, and in some parts extend so far as 30°.

The evidence for the whole sky is therefore not complete by something like a fifth, although there is no reason to think that this missing fraction would seriously affect the results.

The distribution of some of the fainter and therefore presumably much more distant nebulæ was investigated by Hubble in 1934 (*Mt. Wilson Cont.*, No. 485). He eliminated the brighter ones which are included in Shapley's catalogue, and the material consisted of about 44,000 nebulæ distributed over three quarters of the sky north of − 30° Dec. Almost all these are very faint, with a limiting magnitude of 20. A similar piece of work was undertaken about the same time from plates obtained by the Crossley reflector of 36 inches diameter, on which 15,000 small nebulæ were counted up to mag. 19. In neither case was the south circumpolar region represented between − 30° and − 90°, and the plates examined covered only about 2 per cent of the total area available, each plate being taken as a sample of the distribution in that particular region, and covering presumably, in the case of the 100-inch reflector at Mt. Wilson, about a quarter of a square degree of good definition. At the Lick Observatory, the scale of the 36-inch reflector plates was much smaller owing to the shorter focal length, and so covered about three times as much; here 489 plates were examined. The frequency curve of successive photographic magnitudes (Nm) was computed on the assumption that the numbers increased according to an equable distribution of the nebulæ in space. Hubble found that the observed frequency curve of log Nm closely approximated a Gaussian error curve, which would agree with the assumption of equable distribution, if a reasonable dispersion in magnitudes with distance was allowed.

Bok in 1934 again investigated the question, using Hubble's observational material. He calculated the form of the frequency function for the number of systems per unit area of the sky, on the assumption that they are distributed at random. Hubble's observed frequency curve was then compared with the curve of calculated random distribution after ample allowance for dispersion in the limiting magnitudes had been made, and Bok came to the conclusion that this brings out very clearly that the distribution of the faint and distant systems is also not at random. He therefore agrees with Shapley that the general distribution is not homogeneous, and that the tendency to clustering is one of the chief characteristics of the extragalactic universe, so far as we have been able to plumb its depths.

There seems to be little doubt, therefore, that while the uniform distribution is a useful assumption of mathematical necessity, it is certainly not a 'fact of observation'. The evidence of the nearer systems within a radius of 4,000 kiloparsecs is directly contrary to the assumption, while beyond this limit the evidence is quite insufficient to arrive at a definite conclusion in its favour.

The Nutritive Value of Pasteurized Milk

MUCH controversy has arisen over the question whether the bulk of milk sold in Great Britain should be pasteurized or not. There is no doubt that many epidemics have been caused by the consumption of raw milk, which there is presumptive evidence would not have taken place if the infecting bacteria had been destroyed by pasteurization before the milk reached the consumer. On the other hand, experimental evidence has been brought forward to show that the nutritive value of milk is impaired by pasteurization, although in other experiments no significant change in nutritive value could be demonstrated.

The problem is that of producing a 'safe' milk at an economic price; up to the present, the average consumer has refused to pay the higher price of milk obtained from disease-free cows and produced under conditions reducing the risks of contamination to a minimum. However, even under the best conditions, there is always the risk of a worker suffering from an infectious disease contaminating the milk he is handling and so spreading the disease over a wide area, so that adequate heat treatment of the milk may prove the only safeguard, but this can only be recommended with confidence if the nutritive value is not impaired by the heating process, or only impaired in a manner which can easily be remedied.

Towards the end of 1934, an informal conference was called by the Milk Marketing Board's Advisory Committee on Milk Publicity, at which representatives of Government Departments, the Medical Research Council and the Milk Marketing Boards were present: the object of the conference was to consider what further investigations were required on the nutritive value of milk. The conference entrusted the task of conducting these investigations to a special committee—the Milk Nutrition Committee—of which the first report, dealing with the results of work on rats and the direct chemical estimation of vitamin potency, has recently been published[*]. Investigations in schools and with calves will be reported in the near future.

The greater part of the work described in this report has been carried out by Dr. S. K. Kon and his colleagues at the National Institute for Research in Dairying, Shinfield, near Reading: the experiment on the availability of the calcium and phosphorus of pasteurized milk was duplicated at the Rowett Research Institute, Bucksburn, by Dr. D. W. Auchinachie. The same general plan was followed in all the experiments: the samples of raw milk were drawn from the tip tank of the pasteurizing plant after careful mixing, and those of the pasteurized milk were taken after cooling when about half the vat had been emptied. The pasteurization was carried out under commercial conditions by Messrs. Emerson and Chanin, Reading, or at the headquarters of the Aberdeen Milk Pool. The temperature of pasteurization was frequently checked and bacteriological and phosphatase tests were carried out on the milks; in addition, daily estimations of fat and total solids were made during part of the experimental period. The milks were compared as sources of calcium and phosphorus, protein and vitamin B in experiments on rats, and as sources of vitamin A and carotene and vitamin C by chemical tests. The results of these experiments can be quite briefly summarized: pasteurized milk is as good a nutritive agent as raw milk, except in the case of vitamin B_1 and vitamin C.

Since the results of these experiments are of considerable importance, it may be advisable to describe them in more detail, especially as the assessment of the value of the evidence adduced must depend ultimately on the investigators' attention to detail. For the determination of the availability of the calcium and phosphorus in the milks, a complete metabolism experiment was carried out, Kon employing two dozen animals and Auchinachie a dozen. The animals were housed in metabolism cages, in which the excreta could be collected, and the feeding dishes were designed to prevent any scattering of the food. The rats were grouped in pairs according to sex and litter, and the amount of basal diet offered was slightly in excess of that consumed by the animal with the smaller appetite; one animal received raw milk and the other the same amount of pasteurized milk. The basal diet consisted of dried eggwhite, calcium- and phosphorus-free salt mixture, castor sugar, maize starch and butter fat, with supplements of cod liver oil and vitamin B_1 extract. The quantity of milk supplied daily was calculated to supply about 60 per cent and 70 per cent of the normal requirements of calcium and phosphorus respectively. The experiment was continued for five weeks: the deposition of calcium and phosphorus in the tissues of the animals was determined by two entirely independent methods. In the first, the retention was found from the total intake of these elements in the food and milk and the amounts excreted in the urine and fæces. In the second, the retention was estimated from the amounts present in the bodies of the animals at the end and at the beginning of the experiment; the latter figures were obtained by analyses of a similar number of litter mate controls of the same sex as the experimental animals, killed at the beginning of the experiment. For pooled figures the two methods agreed within 0·2 per cent in the case of calcium and 2·0 per cent in the case of phosphorus; the slight discrepancy in the case of phosphorus was probably caused by a small loss during ashing of the rats. The agreement between the two methods indicates that the metabolism experiment had been carried out satisfactorily.

It was found that the animals retained some 80 per cent of the ingested calcium and phosphorus, irrespective of the type of milk given. Statistical treatment of the results showed that pasteurization had no deleterious effects upon the availability of these elements. The only statistically significant differences were a retention by the does on pasteurized milk of 3 per cent more calcium than their litter mates on raw milk and a greater increase in weight of the bucks on raw milk. In all the rats, about 90 per cent of the calcium excreted was found in the urine and about 90 per cent of the phosphorus in the fæces; the reason for the high excretion of calcium in the urine, which is unusual, was not determined.

There was a similar failure to detect any difference between raw and pasteurized milk when the biological value and digestibility of the proteins and the total nutritive values of the milks were compared in experiments on rats. In the latter experiments, the milk was the only food supplied, but was supplemented by the addition of small amounts of iron, copper and manganese: the manganese was shown to be an essential element for growth. Similar experiments on the value of the milks as sources of the vitamin B complex disclosed, however, that pasteurized milk was a significantly less satisfactory source than raw milk: the difference was, however, observed only in the case of the more rapidly growing bucks. The deficient diet used was supplemented by 8 ml. milk daily, an amount which was known to be sufficient for subnormal growth only. This difference between the milks was not seen when larger amounts were given daily, as in the experiments on their total nutritive value, or when the animals grew more slowly, as in the case of the does. The difference might, however, be disclosed during lactation, when the requirements for vitamin B are much greater.

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[*] Milk and Nutrition: New Experiments reported to the Milk Nutrition Committee. Part 1: The Effect of Commercial Pasteurisation on the Nutritive Value of Milk, as determined by Laboratory Experiment. (From the National Institute for Research in Dairying (University of Reading) and the Rowett Research Institute, Bucksburn, Aberdeen.) Pp. 67. (Reading: National Institute for Research in Dairying, Shinfield, 1937.) 2s. 6d. net.

The vitamin A and carotene contents of the milks were determined spectrophotometrically and by the tintometer, on butters churned from both types of milk over a period of five weeks. No destruction of vitamin A or carotene by pasteurization was found. The vitamin C content was determined chemically, by titration with the indophenol reagent, both before and after reduction of the milks with hydrogen sulphide: both the reduced and the reversibly oxidized forms of ascorbic acid showed loss on pasteurization, the loss being greater in the case of the latter. The total loss was about 20 per cent. Milk taken directly from the udder without exposure to light contains only the reduced form of ascorbic acid and can be pasteurized without loss of the vitamin by the holder method, in the absence of copper: the reversibly oxidized form of ascorbic acid is formed by the action of light upon the milk and is affected by pasteurization.*

To sum up, pasteurized milk may contain less vitamin B (presumably B_1) and vitamin C than raw milk, but will in other respects have the same nutritive value. Where milk is not the sole diet, such losses will have no significance, provided the diet also contains cereals and fruit. Where milk is the sole diet, a supplement of fruit juice and a yeast extract or other rich source of vitamin B_1 should obviate any possibility of the diet being inadequate in these respects, although, with a proper intake, the lower content of pasteurized milk in vitamin B is unlikely to be detected and it is now usual to supplement the milk with fruit juice (together with vitamins A and D, in the form of cod liver oil or a concentrated preparation of these vitamins). These experiments suggest that there need be no fear of malnutrition from the universal use of pasteurized milk; admittedly the risk of infectious disease will be considerably reduced.

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* Kon, S. K., and Watson, M. B., *Biochem. J.*, **30**, 2273 (1936).

Bicentenary of Galvani

TEN years ago all Italy joined in honouring the memory of Volta on the centenary of his death; now arrangements are being made at Bologna to commemorate the bicentenary of the birth of his fellow countryman, Galvani, whose discoveries paved the way for those of Volta and led to the invention of the voltaic pile. Though the Galvani celebrations will not be on the same scale as those of ten years ago, they will help to recall the fundamental work done in Italy on current electricity which has had such fruitful results.

Aloisii Galvani was born in Bologna on September 9, 1737, and was thus about eight years older than Volta. After a youth in which theology and mysticism played a part, he settled down to the study of medicine, and in 1762, after writing a thesis "On the Bones, their Nature, and their Formation", was made a lecturer in the University of Bologna and reader in anatomy to the institute of the city. He was successful both as a teacher and a surgeon and became known for his researches in comparative anatomy. It was as an anatomist and physiologist, and not as a physicist, that he made the experiments which have immortalized his name.

The work for which Galvani is remembered was done during the years 1780–91. At least as early as 1780, he began observing the effects on muscular contractions caused by the use of the electrical machine, the Leyden jar and Volta's electrophorus. In 1782 he drew up a paper entitled "On the Nervous Force and its Relation to Electricity". His experiments were made on frogs in particular. Assisted by his nephew, Camillo Galvani, in 1786 he began observations on partly dissected frogs which had been suspended by hooks from the iron rails of the balcony of his house. These he first described in a paper "Esperimenti circa l'Eletricità dei Metalli", and in a Latin dissertation of 62 pages dated October 30, 1786, afterwards to form the most important part of his work of 1791. Galvani was in doubt as to how to explain the effects he observed, and, said J. D. Forbes, who had carefully studied his writings, "in the short space of a few weeks, he had abandoned his earlier notion of the metals being the source of the electricity, and ascribed the effects to the proper electricity of the nerves and muscles". Still pursuing his experiments at intervals, in 1791 he published his most famous, and now very rare, memoir, "De Viribus Electricitats in Motiv Musculari Commentarius", the appearance of which roused great interest in scientific circles.

The first German accounts of Galvani's views were published in 1792 by a young doctor, E. J. Schmuck, and in October of that year Volta wrote his two letters to Cavallo entitled, "Account of some Discoveries made by Mr. Galvani of Bologna, with Experiments and Observations on them". The letters were in French, the first sentence being, "Le sujet des découvertes et des recherches, dont je vais vous entretenir, Monsieur, est l'electricité animale". Volta had sent the letters to be read to the Royal Society as an acknowledgement of his election as a foreign member in 1791. They were read at a meeting of the Society on January 31, 1793, and were duly published in the *Philosophical Transactions*. In 1794, when Volta was awarded the Copley Medal, Sir Joseph Banks in his address said:

> "The experiments of Professor Galvani, until commented upon by Professor Volta, had too much astonished, and, perhaps, in some degree, perplexed many of the learned in various parts of Europe. To Professor Volta was reserved the merit of bringing his countryman's experiments to the test of sound reasoning and accurate investigation. He has explained them to Dr. Galvani himself and to the whole of Europe, with infinite acuteness of judgment and solidity of argument; and through the medium of the *Philosophical Transactions* he has taught us that the various phenomena which presented themselves under the modifications of Dr. Galvani's experiments hitherto tried, are wholly owing to the excessive irritability of the nerves when subjected to the action of portions of the electric fluid, too minute to be discovered, even by the delicate electrometer of our ingenious brother, Mr. Bennet, of Wirksworth; and he has detected in the metals, which Dr. Galvani considered as mere agents in conducting his animal electricity, that very existing principle which the Doctor and his followers had overlooked."

Forbes considered the award of the Copley Medal to Volta, rather than to Galvani, a questionable decision, for "the great value of Volta's paper, at the time, was undoubtedly that it directed the attention of English experimenters to Galvani's discoveries, then quite recent and probably imperfectly known". That Galvani was little known and had not travelled, while Volta was personally known in both Paris and London, may have had something to do with the decision.

From 1791 onwards, Galvani did little more to add to his fame. His wife died, his health declined, and when after the French Revolution the Cisalpine Republic was set up, he declined to take the oath of allegiance to the new authorities and was dismissed from his offices. He died on December 4, 1798, apparently at the house of a brother to which he had retired after his dismissal. His writings were republished in one volume in 1841 by the Academy of Sciences of Bologna.

As regards the oft-repeated story of Galvani's observations on frogs being connected with the preparation of a dish for his invalid wife, Forbes dismisses it as an absurd invention.

Obituary Notices

Prof. D. Morgan Lewis

DAVID MORGAN LEWIS, emeritus professor of physics in the University of Wales, died at Aberystwyth on July 28, aged eighty-five years.

Born at Eglwyswrw, Pembrokeshire, in 1851, he was the eldest son of the Rev. Evan Lewis, minister of the Welsh Independent Church at Brynberian and a prominent figure in his denomination. His early education was received at a local British school and at Cardigan, and later he entered the Presbyterian College, Carmarthen, to train for the ministry. Here he became proficient in mathematics and in 1873 entered Trinity College, Cambridge, where he was 20th Wrangler in 1877. Afterwards he studied physics at the Cavendish Laboratory.

In 1878 Lewis was ordained as minister of the English Congregational Church at Hirwain, Glam., where he served until 1883. The advent of the new Welsh national colleges decided him to seek a wider field and in the latter year he resigned his pastorate and returned to work at the Cavendish Laboratory. In 1884 he was appointed as assistant to Andrew Gray, professor of physics in the new University College of North Wales at Bangor, with whom he worked in full accord until 1891, when he was appointed to the professorship at Aberystwyth in succession to D. E. Jones. Here he worked quietly, and gradually built up an efficient department of physics until his retirement in 1919. He was married in 1894 to Miss Annie Powell of Carreg Cennen, Carms., who predeceased him in 1932.

Prof. Lewis was of a modest and retiring disposition, and greatly disliked publicity. Yet he could be very enthusiastic in those causes which, in his opinion, mattered. While at Hirwain he inaugurated and lectured to classes under the Science and Art Department, and later wrote considerably to the Welsh local Press to stress the importance of scientific and technical education in the new secondary schools which were then being established. He served the University Colleges of Bangor and Aberystwyth and the University of Wales well during their formative years, and the cause of adult education in the Principality found in him a willing helper. During many years, he served as a governor of Aberystwyth County School and was for a period chairman.

After his retirement, Lewis's main interests were in the affairs of his religious denomination, in Welsh hymnology and in archæology. Until quite recently, his quiet, dignified figure could always be seen at the meetings of the British Association, among whose members he had a host of friends. T. C. J.

Dr. Percy Phillips, director of the Hydrological Service of the Physical Department, Egyptian Ministry of Public Works, died in Cairo on August 4, at the age of fifty-seven years. Previous to the Great War, he was a lecturer in physics in the University of London and during the War had a commission in the Sound-Ranging Section of the Royal Engineers, with which he saw service in France and Palestine. He joined the Egyptian Government Service in 1919, and was responsible for the collection and discussion of statistics relating to the water supply of the Nile. He did valuable work in the study of the hydrology of the Nile Basin and in the preparation of the large irrigation projects on the Nile.

We regret to announce the following deaths:

Dr. G. P. Clinton, formerly botanist of the Connecticut Agricultural Experiment Station, known for his work in mycology, on August 13, aged seventy-one years.

Prof. F. B. Loomis, professor of geology in Amherst College, Mass., an authority on vertebrate palæontology, on July 24, aged sixty-three years.

Mr. Andrew Mellon, founder of the Mellon Institute of Industrial Research at Pittsburgh, Pa., sometime American Ambassador in Great Britain, on August 26, aged eighty-two years.

Prof. Luigi Pernier, professor of archæology and the history of ancient art in the University of Florence.

Lord Rothschild, F.R.S., a trustee of the British Museum and founder of the Tring Zoological Museum, on August 27, aged sixty-nine years.

News and Views

Sir Thomas Grainger Stewart (1837-1900)

Sir Thomas Grainger Stewart, the eminent Scotch physician, who died on February 3, 1900, was born at Edinburgh on September 3, 1837. He qualified in 1858, and then visited the medical centres on the Continent, where he came in contact with Virchow, Schönlein and Traube in Berlin, and Oppolzer, Skoda and Hebra in Vienna. On his return to Edinburgh, he was made physician to the university wards in the Royal Infirmary. In 1876 he was appointed professor of physic and proved an exceptionally gifted teacher. He was one of the first in Great Britain to direct attention to the deep reflexes, and under the title of "Paralysis of the Hands and Feet from Diseases of the Nerves", he first described the condition known as multiple neuritis. For many years he held a foremost position as a consultant throughout Scotland and the north of England. His chief publications were "A Practical Treatise on Bright's Diseases of the Kidneys" (1868), "The Teaching of Medicine in Edinburgh" (1877) and "An Introduction to Diseases of the Nervous System" (1884). He was the recipient of many honours. In 1882 he was appointed physician to the Queen in Scotland, in 1887 he was made M.D. *honoris causa* of the Royal University of Ireland, in 1890 he was elected president of the Royal College of Physicians of Edinburgh and honorary fellow of the College of Physicians of Philadelphia, in 1894 he was knighted, and in 1898 he was elected president of the British Medical Association when the annual meeting was held in Edinburgh.

Samuel Siegfried Karl von Basch (1837-1905)

This eminent Austrian physiologist and physician was born on September 9, 1837, at Prague. After studying medicine in his native town and Vienna, he qualified in 1862 in Vienna, where he acted as assistant for several years to Dittel, Jaeger, Turk and Kalisko. In 1865 he went to Mexico, where he was appointed Court physician to the Emperor Maximilian, who was shot on June 19, 1867, and himself narrowly escaped execution. After his return to Vienna he carried out some important experiments on the action of nicotine on the movements of the intestine, and in 1878 was appointed extraordinary professor in experimental pathology. He was the author of numerous publications, but his chief work was "The Physiology and Pathology of the Circulation" (1892), which he dedicated to his former teacher, the celebrated physiologist Karl Ludwig. Basch is best known for his invention of a sphygmomanometer, by which he inaugurated the clinical measurement of the blood pressure. He also did valuable work on pulmonary œdema, cardiac dyspnœa and the innervation of the uterus. His death took place on April 25, 1905.

Local Government in Roman Britain

A DOCUMENT of importance in its bearing on the organization of local government in Roman Britain has been brought to light in the course of the fifth season's excavation on the site of the Roman town of Brough, which has just closed. The investigation of this site, which is situated on the north bank of the Humber, commanding the crossing of the river by the Lincoln-York road, is being carried out by the Brough Excavation Committee under the direction of Mr. Philip Corder and the Rev. T. Romans. The present season's work has been directed to laying bare one of the four towers of rectangular form, twenty-five feet wide by ten feet deep, which were added to the front wall of fortification, possibly early in the fourth century. The most important find of the season was an inscribed slab, 2 ft. 3 in. high by, originally, about four feet long (*The Times*, August 27). Mr. Eric Birley reports on the inscription that it commemorates the provision of a stage at his own expense by Marcus Ulpius Ianuarius, *Ædile* of the village of Petuaria, in honour of the Imperial family of Antoninus Pius (A.D. 138–161) and of the spirits of the deified emperors. This inscription confirms the name Petuaria, and is one of the few known instances of the epigraphic confirmation of Romano-British names.

FURTHER, and more important, the inscription affords evidence of a step in the development of the unit of local governments in Britain from the tribal area, here that of the Parisii, to the self-governing canton with its seat of government at the old tribal capital, or a newly erected town. Although such tribal cantons were known from inscriptions at Caerwent and Wroxeter, this is the first mention of a tribal magistrate in Britain. Furthermore, being denominated as the *Ædile* not of the tribal area, as in the previously known inscriptions, but of Petuaria itself, this indicates, in the interpretation of Mr. Birley, a further stage of development in which the central town with its college of four regular magistrates, two *duovirs* and two *Ædiles*, was gaining in importance at the expense of the tribal organization. This inscription is also the first epigraphic evidence of the practice in Britain of a magistrate conferring benefactions in return for the honour of election to office.

Arctic Weather Reports

ONLY forty-one years have passed since Nansen made his perilous and unsuccessful attempt to drift with the arctic ice from northern Siberia across the North Pole to the neighbourhood of Greenland, yet since July at least one London morning newspaper has been publishing daily a weather report from the region of the North Pole along with similar reports from New York and various Continental capitals. Such observations are not at present of great importance to weather forecasters, because the normal travel of weather systems generally tends to be circumpolar, and, moreover, the gap between the Pole and other arctic weather stations—even Spitsbergen—is a very wide one, so wide that it is impracticable to complete a system of isobars to cover the polar regions. But as a landmark in the gradual spreading of a network of observing stations over the whole world, this event is important. Owing to the drift of the ice, a permanent station at the North Pole is impracticable, but the Russian station from which the published observations have been received has apparently not drifted very far from the Pole yet. Its co-ordinates at the end of August were about lat. 87° N., long. 2° E. The reports include an observation of the direction of the wind, and owing to the fact that these are not made exactly at the Pole, the direction can be given in the ordinary manner. At the Pole itself, of course, all winds are from the south, and direction would presumably have to be given in terms of longitude instead of being referred to the points of the compass.

Problems of Conquering Everest

THE problem of reaching the summit of Mount Everest is discussed in a paper in the *Himalayan Journal*, 9, and takes the form of a memorandum prepared by the Eastern Section of the Himalayan Club, with some comments on the conclusions by Mr. E. Shipton. Two main suggestions are made in the light of past experience. The first is that expeditions have been foredoomed to failure because they have attempted to climb the north ridge too quickly. It is contended that men who have stood the strain of reaching the North Col cannot hope to do the remaining 6,300 feet in three days. The writers quote much evidence in favour of their statement, but Mr. Shipton is equally sure that above 23,000 feet a man deteriorates in muscle and energy quickly, and therefore delay at and above that height must be avoided. The second suggestion is that instead of trying in May and June when the effort is a race with the approaching monsoon, it would be better to make the attempt after the monsoon, in October or even in April. Days in October are certainly shorter than in May, but wind velocities so far as is known are slightly lower. Mr. Shipton admits that post-monsoon conditions should be studied, but prefers the pre-monsoon season. Major K. Mason points out that one obvious drawback to October is that it is a month of increasing wind, while May is a month of west winds decreasing owing to advancing monsoon currents.

The British Grid System

IN a paper on the British Grid system by Johnstone Wright, the engineer of the Central Electricity Board, presented to the Engineering Institute of Canada, at Montreal in June last, an interesting account is given of the development of the Grid system in

(*Continued on p.* 419)

NATURE

SUPPLEMENT

No. 3540 SATURDAY, SEPTEMBER 4, 1937 Vol. 140

The History of Evolutionary Thought as Recorded in Meetings of the British Association*

By Sir Edward B. Poulton, F.R.S.

President of the British Association

SIR WILLIAM THOMSON, in his address at Edinburgh in 1871, said that "the real origin of the British Association" was given in the words of a letter written by David Brewster to John Phillips on February 23, 1831, a few months before the first meeting: "The principal object of the Society would be to make the cultivators of science acquainted with each other, to stimulate one another to new exertions, and to bring the objects of science more before the public eye, and to take measures for advancing its interests and accelerating its progress". That the time was fully ripe for the birth of the Association is made very clear by the words written by John Keble to a friend, referring to the D.C.L. degrees conferred, at the Oxford meeting in 1832, on David Brewster, Robert Brown, John Dalton and Michael Faraday: "The Oxford Doctors have truckled sadly to the spirit of the times in receiving the hodge-podge of philosophers as they did"—an opinion on which Lord Salisbury commented at the Oxford meeting in 1894: "It is amusing at this distance of time, to note the names of the hodge-podge of philosophers whose academical distinctions so sorely vexed Mr. Keble's gentle spirit". It is not only amusing but also pathetic that such words should have been used by a revered member of a University which had done splendid service for science, as has been so well shown in Dr. R. T. Gunther's volumes[1].

Faced by the serious duty of preparing this address, I felt that the best hope of interesting you would be to choose a subject which has received special attention at our meetings. I have selected the progress of thought on organic evolution as it may be followed in addresses, papers, and discussions, mainly restricting myself to the series of meetings which began with the jubilee at York in 1881, the first of many that I have had the pleasure of attending.

The British Association provides a very favourable field for the discussion of many-sided subjects such as evolution—subjects which attract members from very different, as well as from closely related, sections. Hence a wide range of varied experience is open to one who can look back over more than half a century; and I do not propose to exclude some of the humorous sayings and incidents which, from time to time, have enlivened our meetings and contributed to their success. Some of them certainly deserve to be rescued from oblivion, although to perform this pious duty I must risk the enmity of the Goddess of Folly, who as Erasmus tells us, proclaimed: "I hate a man who remembers what he hears".

The fiftieth anniversary at York was a memorable meeting, with Sir John Lubbock (Lord

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* PRESIDENTIAL ADDRESS DELIVERED AT NOTTINGHAM ON SEPTEMBER 1.

Avebury) as president, and the chair of every section except economics, under Grant Duff, taken by a past-president of the Association.

I then enjoyed to the full one of the chief benefits conferred by our Association upon its younger members—the opportunity of meeting older men, up to that time only known to them by the fame of their discoveries. Prof. O. C. Marsh had come over from Yale, his main object being to buy for his University Museum the second and more perfect fossil of the wonderful ancestral bird *Archæopteryx*, with teeth and a long, lizard-like tail—clear evidence of reptilian origin. The earlier example had been bought for the British Museum at a price which was said to have provided the dowry for a professor's daughter, and Marsh soon realized, as he told me, that the second was not for sale on any terms. "We let the other go and I believe they would kill me if this were sold" was the reply given to him by the authority in Munich. He was, however, able to study the fossil, and his description and drawings of the teeth, in the Geological Section, followed the only attack on evolution itself, as distinct from its causes, which I have ever witnessed at any of our meetings. It was the exhibition by H. G. Seeley of his reconstruction of *Archæopteryx* from this fossil, which aroused the fury of the palæontologist, old Dr. Thomas Wright of Cheltenham: "Archæopteryx hasn't got a head, how can it possibly have teeth?" he growled, knowing nothing of the latest find or of the fact that a detached head and scattered teeth had been detected on the slab in which the older specimen was embedded. In spite of Prof. Newton's positive statement and the form of the teeth, drawn by Prof. Marsh at the request of the chairman, Dr. Wright, quite unconvinced, continued muttering "Archæopteryx is a very good bird", its virtue in his opinion entirely uncontaminated by any taint of reptilian affinity.

Prof. Marsh also read a paper in the Zoological Section on his own wonderful discoveries of toothed birds from the rocks of the western United States. Richard Owen, president of the Section, was in the chair and, with the memory of old and embittered controversies in his mind, the author told me that he had felt rather anxious in bringing this communication forward. But in that friendly atmosphere there was no reason for alarm. Owen welcomed the paper warmly and in confirmation told us, in the most charming manner, of the traces of teeth found in an embryo parrot.

FOSSILS AS EVIDENCE OF EVOLUTION

The event which stands out most clearly in my memories of the jubilee meeting is Huxley's evening lecture on "The Rise and Progress of Palæontology"—the science which provides an essential part of the foundation on which geographical, geological and biological evolutionary history has been built. The insuperable difficulty felt by the older naturalists was to believe that the land had been for the most part deposited under the sea, and to account for the presence of fossils, or as they were called, 'formed stones'. The true solution, Huxley explained, was found and published in 1669 by Nicholas Steno, a Danish professor of anatomy at Florence, who carefully studied certain fossils, known as 'glossopetræ', which abounded in the Tuscan rocks and were believed to be fossil fig-leaves. Steno, who was not satisfied with this interpretation, dissected a shark's head and showed that the 'glossopetræ' exactly corresponded in every particular with the teeth—"that in fact they were shark's teeth". The emphasis with which Huxley made this statement comes back to me after the lapse of nearly sixty years. From this, Steno was led to conclude that they were the teeth of shark-like fishes living in the Tuscan Sea and later embedded, with other remains, in the strata which had there accumulated.

I have not noticed the fanciful suggestion of "fossil fig-leaves" in any published version or account of Huxley's lecture that I have seen, but he certainly told us of it and it is an interesting example of the attempts made by the naturalists of the day to explain the fossils embedded in rocks then believed to be of terrestrial origin. I cannot resist the temptation of quoting Plot's[8] more ingenious and amusing effort to account for the well-known layer of oyster-shells (*Ostrea bellovacina*) found ". . . at some places here in *England*, particularly at *Cats-grove* [now Katesgrove] near Reading . . .; which how they should come here without a *Deluge*, seems a difficulty to most men not easily avoided".

Plot was, however, helped "to a *salvo*" for his own objection by remembering that Reading was "a *Town* of very great *action* during the *Invasions* of the *Danes*, who cutting a deep trench cross between the *Kennet* and *Thames*, and inclosing themselves as it were in an *Island*, held it against King *Ethelred*, and *Alfred* his Brother a considerable time; from whence in all probability, the

Saxons having removed their *Cattle* and other provisions before the *Danes* arrival, 'tis likely that they might be supplyed from their *Navy* with *Oysters*, which during the time of the aboad of the *Army* on Land, might be a very suitable employment for it: Which conjecture, if allowed, there is nothing more required to make out the possibility of the bed of *Oysters* coming thither without a *Deluge*, but that *Cats-grove* was the place appointed for the *Armies* repast".

The probability of this suggestion may be inferred from the age of the 'Woolwich and Reading' beds in which the oysters are found—estimated by Prof. W. W. Watts and Prof. H. L. Hawkins at about 50–60 million years.

Dr. Plot's explanation of fossils in general, as well as of flowers, was of a very different kind. To account for their existence he appealed to "the wisdom and goodness of the *Supreme Nature*, by the *School-men* called *Naturans*, that governs and directs the *Natura naturata* here below, to beautifie the World with these varieties; which I take to be the end of such productions as well as of most *Flowers*, such as *Tulips*, *Anemones*, &c. of which we know as little use as of formed stones".

The modest and withal amusing paragraph which follows I venture to quote in full as an example to be followed in scientific controversy:

"And thus I have given the grounds of my present *opinion*, which has not been taken up out of *humor* or *contradiction*, with intent only to affront other worthy Authors modest conjectures, but rather friendly to *excite them*, or any *others*, to endeavor collections of *shell-fish*, and parts of other *Animals*, that may answer such *formed stones* as are here already, or may hereafter be produced: Which when ever I find done, and the reasons alleged *solidly* answered, I shall be ready with acknowledgment to retract my *opinion*, which I am not so in love with, but for the sake of *Truth* I can chearfully cast off without the least reluctancy".

One chief object which, as I believe, Huxley had before him was to bring forward a calm, clear statement of the evidence on which alone it was possible to achieve that "reconstruction of an extinct animal from a tooth or bone", which had made so deep an impression on the imagination. The reconstruction was in fact a simple inference based on anatomical experience such as that gained by Steno when he dissected the shark and concluded that the 'glossopetræ' were the teeth of shark-like fishes. But this reasoning—that a fossil tooth or bone on the surface of a rock, cannot by itself enable the geologist to predict that a skeleton of a certain type lies hidden beneath—seeming to diminish the glory of Cuvier's splendid work, was resented by Owen, who had replied with the bitter taunt that a tooth can tell us a great deal—a donkey can kick his master but he cannot eat him. This may have been the encounter referred to by Huxley when he wrote of a friendly meeting with Owen at the Zoological Section of the Association in Leeds (1858): "so that the people who had come in hopes of a row were (as I intended they should be) disappointed"[3]. In the same spirit, I think, Huxley was glad to speak of the 'glossopetræ' at the jubilee meeting, where Owen was president of a section, and calmly and simply, to reaffirm conclusions which are unassailable.

Huxley then passed on to Steno's further study of fossils and his proof of their relationship to terrestrial freshwater and marine organisms, and to his application of this evidence to the past condition of Tuscany—all discussed "in a manner worthy of a modern geologist" and later extended by Buffon to all parts of the world then known to be fossiliferous. These conclusions, "which almost constitute the framework of palæontology", only required one addition, made towards the end of the eighteenth century by William Smith, who showed that geological strata contained characteristic fossils so that rocks of the same age could be identified in all parts of the world, while the biologist could follow the changes in the living population of the globe—a record of constant extinction and continual generation of new species. We were then led to three general conclusions: (1) the vast length of time during which life has existed on the earth—"certainly for millions of years"; (2) the continual changes which living forms have undergone during this period; (3) the successive changes in the best-known fossil groups are such as we should expect if each series "had been produced by the gradual modification of the earliest form. . . .". This last conclusion meant evolution which so completely accorded with recent discoveries that "if it had not existed, the palæontologist would have had to invent it".

I can never forget the words spoken to me after the lecture by a dear friend of my youth, the late Viriamu Jones, Principal of University College, Cardiff: "At every sentence I felt myself bowing to Huxley and saying 'you are the greatest man here; no one else could have said that as you have said it' ".

AGE OF THE EARTH

As Huxley's lecture continued in a calm spirit an embittered controversy, so his thoughts on the immensity of past geological and biological time lead naturally to another controversy on the age of the earth conducted intermittently at our meetings between 1892 and 1921. It is, I think, a good example of the invaluable help which the British Association brings to discussion when there appears to be a difficulty in reconciling the conclusions reached by the followers of different sciences. Lord Kelvin's estimate of a hundred million years as the period during which the earth had been cool enough to permit the existence of life upon its surface—a period reduced by Prof. Tait to ten million—was a great difficulty to geologists and biologists, who believed that an immensely longer time was required for the history of the fossiliferous rocks and the evolution of animals and plants. Thus, to quote only one instance, Darwin writing to Wallace in 1871 and referring to 'missing links', said, "I should rely much on pre-Silurian time ; but then comes Sir William Thomson, like an odious spectre". The geologists resisted more firmly. Thus Sir Archibald Geikie, in his presidential address at Edinburgh in 1892, concluded his discussion of the subject with these words : "The geological record furnishes a mass of evidence which no arguments drawn from other departments of Nature can explain away, and which, it seems to me, cannot be satisfactorily interpreted save with an allowance of time much beyond the narrow limits which recent physical speculation would concede".

At the Leeds meeting in 1890 I had many opportunities of meeting Prof. John Perry, and when we were walking together on the Sunday afternoon, I asked him to tell me something of the Kelvin-Tait conclusions and how far they must be accepted. He had been a demonstrator under Kelvin and spoke of the intense interest with which he had followed his lectures at Glasgow, and he gave me no hope of escape. His change of opinion, throwing a most interesting light upon the influence of the British Association, was the result of the presidential address at Oxford in 1894, when Lord Salisbury chaffed the believers in natural selection, telling them that he did not wonder that they required many hundred million years for so slow a process, but that "if the mathematicians are right, the biologists cannot have what they demand. . . . The jelly-fish would have been dissipated in steam long before he had had a chance of displaying the advantageous variation which was to make him the ancestor of the human race".

When Perry read this pronouncement, sweeping aside the firm convictions of biologists and geologists, he was led to re-examine the evidence and soon found a flaw. The heat of the earth had been calculated on the assumption of a conductivity uniform through the whole mass, but Perry showed that, with a conductivity becoming higher with increasing depth, the Kelvin-Tait estimate of the time required for cooling to the existing temperature—on which the age of the habitable earth had been based—must be immensely lengthened. Perry told me of this destructive criticism and very kindly helped me to make use of it in the address to Section D at Liverpool in which I replied to Lord Salisbury's amusing attack on the evolutionists.

Lord Lister was our president at Liverpool in 1896, and I cannot resist the temptation to digress for a moment and recall the address in which one of the greatest benefactors of mankind told us, with the utmost simplicity and modesty, the story of his life's work and the success which, in spite of all opposition, had been achieved. To hear him was an enduring inspiration.

The year 1896 was also the jubilee of Lord Kelvin's wonderful half-century of achievement in research and teaching, and I could not help feeling some regret that any criticism of his work should appear at this particular time. But in the kindly spirit of our Association such doubts were quite unnecessary. I well remember how he came one day to our sectional committee-room to bring me some volumes of his works, and how, as I have recorded before, in the following year as we were travelling across Canada after the Toronto meeting and the chance of collecting insects for a few minutes at each station could not be resisted, Lord Kelvin said to his wife, "My dear, I think we must forgive Poulton for thinking that the earth is so very old when he works so hard in one day out of all the endless millions of years in which he believes !"[4]

The one line of evidence which left some anxiety in 1896 was suggested by Helmholtz, who allowed the sun only eighteen million years to have been giving out radiant heat at the present rate—a period Lord Kelvin was willing to extend to 500 million—and this estimated maximum was also accepted by Sir George Darwin, who, in his address[5] at Cape Town in 1905, spoke of the new evidence obtained by M. and Mme. Curie in their proof that radium gives out heat, and quoting in confirmation the work of R. J. Strutt, W. E. Wilson and G. H. Darwin, finally concluded that "the physical argument is not susceptible of a greater degree of certainty than that of the geologists, and the scale of geological time remains in great measure unknown". The light thrown by radium upon the Helmholtz estimate was also referred to in the presidential address of Ray Lankester at York in 1906, of J. J. Thomson, quoting the work of Strutt, Joly and Rutherford, at Winnipeg in 1909, and became a predominant subject in the joint discussion on the age of the earth, between Sections A, C, D and K, at Edinburgh in 1921[6]. Lord Rayleigh, in opening this discussion, concluded "that radioactive methods of estimation indicate a moderate multiple of 1,000 million years as the possible and probable duration of the earth's crust as suitable for the habitation of living beings. . . ."

Geologists and biologists do not profess to know the age of the earth as the abode of life, but they are sure that, in the words used by Sir William Turner at Bradford in 1900, its birth "must have been in the far-distant past, at a period so remote from the present that the mind fails to grasp the duration of the interval".

ORGANIC EVOLUTION

I fear that too much of our time has been occupied by the attempt to show that the field is clear for the discussion of organic evolution, but until this could be done any such discussion appeared to be wellnigh useless.

It is, I think, a mistake to emphasize too strongly the very natural shock received by many who read the "Origin" or heard of its teaching for the first time and without any preparation; and I believe an even greater mistake to criticize the clergy for the time that elapsed before their acceptance of the new teaching. I shall never forget the reception of Aubrey Moore's paper, "Recent Advances in Natural Science in their Relation to the Christian Faith", by the Church Congress at Reading in 1883[7]. No speaker could have carried his audience with him more thoroughly: there was not a single protest or indication of dissent—nothing but enthusiastic applause. The Bishop of Oxford, Dr. Mackarness, was in the chair when the paper received this unanimous welcome—only twenty-three years after the Oxford meeting at which another Bishop of Oxford put his rude and foolish question to Huxley. It is pleasant to know that their celebrated encounter left no bitterness, for Huxley wrote in 1891 to Francis Darwin—"In justice to the Bishop, I am bound to say that he bore no malice, but was always courtesy itself when we occasionally met in after years".

I remember as a youth receiving a gentle parental warning against committing myself too entirely to a belief in evolution—a very different experience from that of our president at Hull in 1922, Sir Charles Sherrington, who in 1873 was persuaded by his mother to take the "Origin" with him on his summer holiday, with the inspiring words—"It sets the door of the Universe ajar!"

I have already recalled Dr. Wright's indignation at York in 1881 as my only experience of opposition to a belief in organic evolution at any of our meetings, and the published proceedings confirm this impression of unanimity. Thus, R. H. Traquair, addressing the biologists at Bradford in 1900, said, "I hardly think that we should now find a single scientific worker who continues to hold on to the old special creation idea"; and Lord Salisbury at Oxford in 1894, referring to Darwin, said, "He has, as a matter of fact, disposed of the doctrine of the immutability of species. It has been mainly associated in recent days with the honoured name of Agassiz, but with him has disappeared the last defender of it who could claim the attention of the world". The mention of this great American naturalist recalls Tyndall's fine address at Belfast in 1874 and his memories of Agassiz's words, "I was not prepared to see this theory received as it has been by the best intellects of our time. Its success is greater than I could have thought possible".

Huxley, who had seconded the vote of thanks to Lord Salisbury, wrote to Hooker a few days later: "It was very queer to sit there and hear the doctrines you and I were damned for advocating thirty-four years ago at Oxford, enunciated as matters of course—disputed by no reasonable man!—in the Sheldonian Theatre by the Chancellor. . . ."[8]

A letter written two days earlier to Boyd Dawkins records Huxley's opinion of another part of the address. "Lord Salisbury gave himself away wonderfully, but he was so good about Darwin himself that I shut my eyes to all the nonsense he talked about Natural Selection"[9].

Motive Causes of Organic Evolution

Leaving now the subject of organic evolution itself, as generally accepted, I wish to speak on the difficult question of its motive causes which for many years have formed the subject of addresses, discussions and papers at our meetings. The great division into two opposed theories of causation became clear in 1887, when Weismann attended the meeting at Manchester, and a discussion on "The Hereditary Transmission of Acquired Characters" was held in Section D. From that time, evolutionists attending our meetings have been either 'Lamarckians', following Erasmus Darwin, Lamarck, Buffon and Herbert Spencer, or 'Darwinians' who followed Darwin and Wallace. Darwin himself, however, included the Lamarckian conception of 'use-inheritance' as a motive cause, although believing it to be far less important than natural selection. The term 'Neo-Darwinian' has therefore been applied to those who, accepting Weismann's teaching, reject 'use-inheritance' altogether.

It must always be remembered that, apart from any theory of causes, the world owes its belief in organic evolution to all the great men whose researches and teaching have founded the two schools, and perhaps chiefly, at any rate among the English-speaking nations, to Herbert Spencer. I was first led to realize the extent of his trans-Atlantic popularity when I learned from an American story greatly enjoyed in those far-off undergraduate days, that his books were keenly appreciated by a bashful hero, who was so far from sharing the sublime confidence of their author, that he was only led to perform the most fateful action in life by the pressing advice of a very young nephew who assured him, in the presence of the lady, that if he was fond of her, the proper thing to do was to kiss her. Herbert Spencer's infallibility certainly lent itself to such stories as that of his supposed reply to an argument—"That can't be true, for otherwise 'First Principles' would have to be re-written—and the edition is stereotyped" ; or how Darwin said that to read Spencer always made him feel like a worm, but that he retained the worm's privilege of wriggling, and at another time "wonderfully clever, and I dare say mostly true". But, allowing for a style which provoked these and other amusing comments, we must never forget that believers in the doctrine of organic evolution owe an immeasurable debt to Herbert Spencer.

James Russell Lowell's amusing lines in the "Biglow Papers"[10] appear to prove that Lamarckism was prevalent in America many years before the "Origin" :

"Some flossifers think thet a fakkilty's granted
The minnit its proved to be thoroughly wanted,

. . . . .

Ez, fer instance, thet rubber-trees fust begun bearin'
Wen p'litikkle conshunces come into wearin',—
Thet the fears of a monkey, whose holt chanced to fail,
Drawed the vertibry out to a prehensile tail".

The year of the Manchester meeting, 1887, was the fiftieth anniversary, and we are now celebrating the centenary, of the entry in Darwin's pocket-book :

"In July opened first note-book on Transmutation of Species. Had been greatly struck from about the month of previous March on character of South American fossils, and species on Galapagos Archipelago. These facts (especially latter), origin of all my views".

It is especially interesting to recall that these views, as Prof. Newton told us in his address to Section D, the biological section, did not include natural selection, which only came into Darwin's mind when he read Malthus, "On Population", in October 1838. Newton, who had read the proof-sheets of the great "Life of Darwin", published later in 1887, then spoke of Wallace's independent discovery, made twenty years after Darwin's, a discovery suggested to him also by reflecting on Malthus, and of the friendship between the two great men to whom this fruitful conception had come, referring the cynic who would "point the finger of scorn at the petty quarrels in which naturalists unfortunately at times engage" to this "greatest of all cases, where scientific rivalry not only did not interfere with, but even strengthened, the good-feeling which existed between two of the most original investigators". Here I cannot resist the desire to quote a part of the speech made by Wallace at the most thrilling scientific gathering I have ever attended—the fiftieth anniversary of the Darwin-Wallace essay read before the Linnean Society on July 1, 1858, only twelve days after the arrival of Wallace's letter and manuscript from the Moluccas. Wallace then said, on July 1, 1908 :

"The idea came to me, as it had come to Darwin, in a sudden flash of insight : it was thought out in a few hours . . . and sent off to Darwin—all within one week. *I* was then (as often since) the 'young man in a hurry' : *he*, the painstaking and patient student, seeking ever the full demonstration of the truth that he had discovered, rather than to achieve immediate personal fame. . . . If the persuasion of his friends had prevailed with him, and he had published his theory, after ten years'—fifteen years'—or even eighteen years' elaboration of it—*I* should have had no part in it whatever, and *he* would have been at once recognized, and should be ever recognized, as the sole and undisputed discoverer and patient investigator of the great law of 'Natural Selection', in all its far-reaching consequences"[11].

Amusing evidence of the difficulty with which this "great law" was understood is afforded by a verse written by Lord Neaves and dated May 1861 :

"A deer with a neck that was longer by half
Than the rest of its family's (try not to laugh),
By stretching and stretching, became a Giraffe,
Which nobody can deny"[12].

Yet Wallace, referring to Lamarck's hypothesis and "that now advanced", had written in his section of the joint essay :

> "Neither did the giraffe acquire its long neck by desiring to reach the foliage of the more lofty shrubs, and constantly stretching its neck for the purpose, but because any varieties which occurred among its antitypes with a longer neck than usual *at once secured a fresh range of pasture over the same ground as their shorter-necked companions, and on the first scarcity of food were thereby enabled to outlive them*".

There were fortunately others who did not launch such ill-aimed criticism. Thus Prof. Newton, reminding the Section that the new teachings had been at once accepted by Canon Tristram[13] before the appearance of the "Origin of Species" (on November 24, 1859), expressed, with all the enthusiasm of one who was devoted to the same delightful branch of natural history, "the hope that the study of ornithology may be said to have been lifted above its fellows". It was indeed very fortunate that the Darwin-Wallace essay should have been read so soon after its appearance by a naturalist who looked on the species question as did Tristram—a great traveller and observer who studied indefatigably the birds he loved, as living creatures and in as many countries as he could visit.

At the last meeting of the British Association in Nottingham (1893) Canon Tristram was president of Section D and, in his address, gave an account of the observations referred to by Newton at Manchester. The historic interest of this early acceptance of natural selection is such that I have prepared a brief abstract of his chief conclusions :

During a visit of many months to the Algerian Sahara in 1857–58, he "noticed the remarkable variations in different groups, according to elevation from the sea, and the difference of soil and vegetation". On his return he read the Darwin-Wallace essay and wrote, "It is hardly possible, I should think, to illustrate this theory better than by the larks and chats of North Africa". He then explained how the colours arose by selective destruction of birds which harmonized less well than others with the surface of the desert ; and similarly with other larks having "differences, not only of colour, but of structure", chiefly "marked in the form of the bill". He took as examples a very long-billed lark (*Galerita arenicola*), resorting exclusively to the deep, loose, sandy tracts, and a very short-billed allied species (*G. isabellina*), haunting the hard and rocky districts. He then pointed out that there is individual variation in the bills of larks and that the shorter-billed birds would be at a disadvantage in obtaining food from sandy areas but at an advantage among the rocks where strength is required. He concluded, "Here are only two causes enumerated which might serve to create, as it were, a new species from an old one. Yet they are perfectly natural causes, and such as I think must have occurred, and are possibly occurring still. We know so very little of the causes which, in the majority of cases, make species rare or common that there may be hundreds of others at work, some even more powerful than these, which go to perpetuate and eliminate certain forms 'according to natural means of selection' ".

The temptation to record an amusing incident which happened at one of the meetings of Section D at Manchester cannot be resisted. Work was proceeding smoothly under the genial guidance of Prof. Newton when, suddenly, Dr. Samuel Haughton of Dublin entered and from the back of the room announced in arresting tones that he had an important communication to make about the animals preserved from the Flood. He believed that Mrs. Noah strongly objected to her husband's intention to take the elephants on board, fearing that their weight would cause a dangerous displacement of the Ark's metacentre.

How this domestic difference was composed we had no opportunity of learning, for as the chairman, whose expression combined sympathetic amusement with mild deprecation, was rising and about to protest, Dr. Haughton, anticipating the result, had already turned towards the door, telling us over his shoulder that he was on his way to make a fuller communication on the subject to the Anthropological Section.

ACQUIRED CHARACTERS

After this brief description of an event, which I hope you will agree ought not to be forgotten, we must return to organic evolution and to one of the most important subjects debated at any time before a meeting of the British Association—the question, "Are Acquired Characters Hereditary ?" —brought before the world by Prof. August Weismann, who was present at Manchester and spoke in the discussion (unfortunately not reported), introduced by Ray Lankester, in which Dr. Hubrecht, Patrick Geddes, Marcus Hartog and I took part. Weismann's conclusion that "acquired characters" are *not inherited was held* by Prof. E. S. Goodrich, in his address to Section D at Edinburgh in 1921, to be "the most important contribution to the science of evolution since the publication of Darwin's 'Origin of Species'", an opinion with which the great majority of biologists will agree, although the terms employed for the two classes, the inherited and the non-inherited, together with the ideas underlying them, were shown by Adam Sedgwick, at Dover in 1899, Archdall Reid, and others, as well as by Goodrich himself, to be incorrect. Nevertheless it will probably be impossible to abandon the word 'acquired', employed by Erasmus Darwin (1794), Lamarck (1809), and Prichard (1813) as well as by later authorities. Whenever environmental conditions are followed by characteristic changes, absent when these conditions are absent; or when such changes follow the use or disuse of the parts of an organism, or the education it has received, then we have before us the 'acquired' characters maintained by Weismann to be incapable of hereditary transmission. This vital conclusion, accepted, as I believe it is, by nearly all biologists, is not appreciated as it ought to be by the general public. A brief statement of a single piece of evidence may convince some who are doubtful about a conclusion with which human life is very deeply concerned.

My old friend the late A. A. Macdonell, professor of Sanskrit at Oxford, spoke two languages, English and German, as they are spoken by native Englishmen and Germans. I asked him whether he thought it was possible for any mature person to learn a foreign language so perfectly that he would be mistaken for a native. He replied that he was sure it could not be done, and that his own ability to speak the two languages as he did had been only made possible because as a small child he had been continually taken backwards and forwards between the two countries. Yet any human being transported as a baby from his own country to another and brought up there among the natives will learn to speak as they speak. All the past generations, however many, during which his ancestors spoke the language of his birthplace, will count for nothing, will not retard his acquisition of another tongue or modify it in any way.

An interesting and amusing example is provided by the futile striving of an Englishman to pronounce the Welsh double-l, generally attempted by the substitution of 'th'. Even the advice given by a Welsh clergyman to the English bishop of his diocese is unlikely to bring success: "You must put the tip of your Right Reverend tongue against the roof of your Right Reverend mouth, and hiss like a goose".

The result of education as an 'acquired' character in the Weismannian sense is of such special importance that I think it is well to quote the conclusions stated by Ray Lankester in his address to the seventy-fifth meeting of the Association at York. He then maintained that the "power of building up appropriate cerebral mechanism in response to individual experience, or what may be called 'educability', is the quality which characterises the larger cerebrum and is that which has led to its selection, survival and further increase in volume . . . 'Educability' can be transmitted; it is a congenital character. But the *results* of education can *not* be transmitted. In each generation they have to be acquired afresh. . . . On the other hand, the nerve-mechanisms of instinct are transmitted, and owe their inferiority as compared with the results of education to the very fact that they are *not* acquired by the individual in relation to his particular needs, but have arisen by selection of congenital variation in a long series of preceding generations"[14].

Lankester was led by these conclusions to reject altogether the theory of G. H. Lewes, G. Romanes, and others, "that instincts are due to lapsed intelligence", a theory also disproved by Lloyd Morgan's observations on young birds described by him at the Ipswich meeting in 1895[14]. Another very important subject brought forward by Lankester was the evidence, originally published by him in 1894[15], that Lamarck's first and second laws of heredity "are contradictory the one of the other, and therefore may be dismissed". His statement may be briefly summarized as follows:

The first law assumes that in spite of thousands of generations during which a normal environment has "moulded the individuals of a given species of organism, and determined as each individual developed and grew 'responsive' quantities in its parts (characters); yet, as Lamarck tells us, and as we know, there is in every individual born a potentiality which has *not* been extinguished. Change the normal conditions . . . and (as Lamarck bids us observe), in spite of all the long-continued response to the earlier normal specific conditions, the innate congenital potentiality shows itself. The individual . . . shows *new* responsive quantities in those parts of its structure concerned, new or acquired characters".

"So far, so good. What Lamarck next asks us to accept, as his 'second law', seems not only to lack the support of experimental proof, but to be inconsistent with what had just preceded it. The new character which is *ex hypothesi*, as was the old character . . . which it has replaced—a response to environment . . . is, according to Lamarck, all of a sudden raised to extraordinary powers. The new or freshly acquired character is declared . . . to be capable of transmission by generation; that is to say, it alters the potential character of the species. It is no longer a merely responsive or reactive character, determined quantitatively by quantitative conditions of the environment, but becomes fixed and incorporated in the potential of the race, so as to persist when other quantitative external conditions are substituted for those which originally determined it".

The effect of Lamarck's laws on the hereditary transmission of acquired characters would be this: "a past of indefinite duration is powerless to control the present, while the brief history of the present can readily control the future".

After hearing a very condensed statement of conclusions so essentially bound up with the progress of organic evolution, I feel sure that you will wish to be reminded of Prof. Ewing's words which followed the address at York:

"Now is the winter of our discontent made glorious summer by this Ray of Lankester".

Returning to the unreported discussion on the inheritance of acquired characters at Manchester, I venture to bring forward certain observations opposed to a belief in Lamarckian evolution by means of inherited experience—observations which I then described and have not known to be answered. In the relationship between enemy and prey there is very commonly no opportunity for the latter to learn by experience. The wonderfully elaborate adaptations by which sedentary insects are hidden from enemies have been evolved, not by experience of enemies but by avoidance of enemies. In these examples—and they are numberless—we are driven to accept Weismann's conclusion and with him to invoke "the all-sufficiency of Natural Selection".

When one of the twig-like caterpillars, of which there are so many in Great Britain, is detected by an insectivorous bird, it can do nothing and is devoured at once. Its one defence is the astonishingly perfect resemblance to a twig of the bush or tree on which it lives. It is firmly fixed and its weight also supported by an almost invisible thread so that it cannot escape as many caterpillars do by dropping to the ground and sheltering in the grass or among dead leaves. Its one chance of survival is to gain so perfect a disguise that it will not be seen, and to gain this end the adaptive devices are most elaborate and wonderful: its twig-like shape and colours, with the power of gradually adjusting these so as to resemble the bark of the bush or tree on which the parent moth laid the egg from which it came, even the power to reproduce exactly the appearance of lichen, the rigid stick-like attitude maintained during the hours of daylight. Finally there is the evidence, recently obtained by Robert Carrick[17], that the disguise *does* protect; for examples of one of these caterpillars, resting on a branch of its food-plant fixed over a wren's nest containing young, were unnoticed by the parent bird which used the same branch as a convenient perch; yet seen and at once taken when placed on a white surface below.

One of the best examples of a prophetic instinct is to be found in the larva of an African Tabanid fly (*T. biguttatus*). This maggot lives and feeds in soft mud which, during the dry season when the chrysalis stage has been reached, will be traversed in all directions by wide and deep cracks in which insectivorous animals can search for prey. But the maggot, while the mud is still soft, prepares for this danger. By tunnelling spirally up and down it makes a line of weakness which will cause a pillar to separate from the mass when the mud hardens and contracts. It then tunnels into the still soft pillar and becomes a chrysalis in the centre of its deeper end. However wide the cracks which appear in the mud, the maggot has arranged beforehand that they will not invade its cylinder. Dr. W. A. Lamborn, who made this most interesting discovery, observed that the summits of the pillars, forming circular disks of about the size of a penny, scattered here and there over the surface, were never thus traversed, but that an empty shell was protruding from the centre of each when the fly had emerged[18]. My friend the late Prof. J. M. Baldwin, the distinguished American psychologist, well remembered at many of our meetings, wrote when he heard of this discovery: "it seems *complete*—one of those rare cases of a single experience being sufficient to establish both a fact and a reason for the fact! It is beautiful".

I would ask any believer in Lamarckian evolution, or in Hering's and Samuel Butler's theory of unconscious memory residing in the germ-cells, how it would be possible to explain these prophetic instincts, adapted not to meet but to avoid future experience, except by the operation of natural selection.

The appeal to orthogenesis, or internal developmental force, as the motive cause of evolutionary progress, has often been made—generally by palæontologists rather than by the observers of living forms. Any such belief in the potency of an internal tendency is, I think, open to the criticism made by Thiselton Dyer in his address to Section D at Bath in 1888: "This appears to me much as if we explained the movement of a train from London to Bath by attributing to it a tendency to locomotion. Mr. Darwin lifted the whole matter out of the field of mere transcendental speculation by the theory of natural selection, a perfectly intelligible mechanism by which the result might be brought about. Science will always prefer a material *modus operandi* to anything so vague as the action of a tendency".

MENDELISM

It is not necessary for me to speak on the rediscovery of Mendel's great work and all that it has meant to our biological sections in the early decades of the present century. The recent developments, following the work of Haldane, R. A. Fisher and others, and the vitally important relationship between Mendelism and natural selection were brought before us last year in Julian Huxley's illuminating address to Section D. The older belief that only large variations, or mutations as they then began to be called, were subject to Mendelian inheritance, and that small variations were not inherited at all, disappeared when further researches proved that extremely minute differences were "heritable in the normal manner"[19], and, with this, the foundation of Darwinian evolution became immensely strengthened. It is also right to remember that Bateson, the leader of Mendelian research in Great Britain, always believed in natural selection, regarding it indeed as self-evident and not very interesting. Also that Ray Lankester, as long ago as his 1906 address at York, maintained that however far Mendelism was advanced, it "would not be subversive of Mr. Darwin's generalisations, but probably tend to the more ready application of them to the explanation of many difficult cases of the structure and distribution of organisms".

The relationship between the germinal foundation of Mendelian and Weismannian heredity was considered in a paper by L. Doncaster read before Section D at the South African meeting in 1905. He then maintained that Weismann's "hypothesis that the material bearer of hereditary qualities is the chromatin of the nucleus" of the germ-cells had been confirmed by recent work on their maturation, which "has shown that they contain a mechanism which seems precisely adapted to bring about that segregation of characters which forms the most fundamental part of the Mendelian theory, and it seems hardly possible that the two things are unconnected". MacBride also in his address to the same section at Newcastle in 1906, spoke of the "great epoch-making discovery of experimental embryology, viz. the existence of *specific organ-forming substances*".

These fundamental discoveries bring to mind a conversation with Weismann when he had been finally driven to frame and elaborate this hypothesis, and was so appalled by the number and minuteness of the material bearers of hereditary qualities contained in a single germ-cell that, as he told me, he could not believe that the physicists and chemists were correct in their conclusions about the size of the atom. He admitted that diverse lines of evidence led to the same result, but even so, he believed the future would prove that physicists were mistaken and that the atom was far smaller.

NATURAL SELECTION TO-DAY

It is impossible to say more than a few words about the very interesting and important discussion on "The Present State of the Theory of Natural Selection" held at the Royal Society on May 14 last year. The subject was approached from many points of view by both zoologists and botanists, and their conclusions were very welcome to Darwinians who remembered the earlier opinions expressed when Mendel's great work was rediscovered. I think, however, that Prof. D. M. S. Watson, in the opening address, was inclined to underestimate the value of the existing evidence for a "selective death rate", although everyone will agree that "any new evidence . . . or indeed any suggestion of cases which might be capable of investigation", would be most desirable.

I may briefly mention a few experiments brought before Section D at the Bristol meeting in 1898, beginning with the work of Weldon and Thompson on the common shore crab, showing that the effect of china clay and other impurities in the sea at Plymouth was selective and promoted changes of shape which ensured that the water flowing over the respiratory surface was more efficiently filtered.

Then, on the subject of chance, the heroic help rendered by Mrs. Weldon, who four times recorded the result of 4,096 throws of dice, showing that the faces with more than three points were, on the average, uppermost slightly more often than was to be expected. It comes back to me very clearly because of the interesting explanation—that the points on dice are marked by little holes scooped out of the faces, and that points 6, 5, and 4, respectively opposite 1, 2, and 3 are somewhat lighter, more of the ivory having been removed; also because of Francis Galton's delight and his humorously expressed wonder whether the facts had been realized by those who had an interest other than scientific in the throwing of dice.

Experimental evidence was also submitted by Miss Cora B. Sanders (Mrs. C. B. S. Hodson) and myself, proving that when the rough, angular pupa of the small tortoiseshell butterfly "is suspended from a surface against which it stands out conspicuously, it is in far greater danger than when it is fixed to one upon which it is concealed".

To the observer of living creatures, however, the most convincing evidence is provided by animals themselves. When a wild bird is seen to capture some conspicuous butterfly or moth and then immediately to reject it, the association between inedibility and a warning colour is more convincingly suggested than when insects are offered to animals in confinement, although such experiments are of great value and often provide the only available evidence. There are, however, instances in which abundant data for statistical investigation are furnished by the wild animals themselves. Thus the long-eared bat has the convenient habit of eating moths—its regular food—while it hangs suspended from a surface to which it returns after each capture; and as the wings are rejected, these may be collected in large numbers, yielding valuable information on the significance of concealing and warning patterns.

In the attempt to determine the motive causes of organic evolution, the work of the naturalist, the student of living nature, is essential. His task is to do what Lyell did for geology by directing attention to the forces now in operation and seeking with their help to interpret the past, and in this work it is especially valuable to study adaptations which have been developed in recent times and can, in certain instances, be proved to undergo changes even now. Thus the interesting observations of H. Lyster Jameson showed that a pale local race of the common mouse had been formed, although incompletely, in 100–125 years, by the selective attacks of owls and hawks on sandhills near Dublin[30]. I therefore believe that the colours of animals provide one of the most fruitful fields in which to pursue these investigations, and I regret that this work has been recently attacked by an American zoologist who, referring to the recent revival of natural selection, continues—"if the doctrine can emerge minus its sexual selection, its warning colors, its mimicry and its signal colors, the reaction over the end of the century will have been a distinct advantage"[31]. It is of course impossible to discuss, on the present occasion, this confident attempt to depreciate the value of work associated with the names of Bates, Wallace, Trimen and Fritz Müller. I will only point out that their conclusions on warning colours and mimicry have been immensely strengthened and confirmed by the later observations of Guy Marshall, W. A. Lamborn, St. Aubyn Rogers, Hale Carpenter, V. G. L. van Someren and others in Africa; by the experiments conducted by some of these naturalists, and also by H. B. Cott and R. Carrick, and in the United States by Morton Jones.

It is interesting to remember that a paper by two American entomologists[32] was among the first to accept and support by fresh observations the conclusions brought forward by H. W. Bates in his great memoir on the mimetic butterflies of the Amazon valley[33], and that one of the authors treated the same subject more completely in a later paper[34] much appreciated by Darwin[35].

It is also important to remember that the above-mentioned conclusions have been reached by the study of marine animals no less than terrestrial, as was shown by Herdman in his address to Section D at Glasgow in 1901, and by his experiments communicated to the same section at Ipswich in 1895; also that Garstang, with his very long and intimate experience of marine life, adopts the same interpretation of colour and form with the associated attitudes and movements.

If time permitted it would be possible to speak of numerous papers on mimicry and the related subjects which have been brought before our meetings. It is impossible to attempt this now, but many will feel with me that the name of the late Dr. F. A. Dixey should not be forgotten—one who attended so regularly, so often read papers at our meetings, presided over Section D at Bournemouth in 1919, lectured at Leicester in 1907, always giving the results yielded by the study of his favourite insects, and their interpretation by the theory of natural selection; also one who delighted in the social gatherings of his Section.

MAN AND ANIMALS

In my concluding remarks I am anxious to refer to a very interesting and encouraging subject—the feeling for animals and the care for their welfare to-day, as contrasted with the treatment they received a hundred years ago and even in the youth of many among us. Only last autumn, *The Times* of October 12 reported that 1,000 swallows had arrived at Venice "sent there by bird-lovers from Vienna and Munich in order to save them from the effects of the cold weather. Soon after their arrival they were set free and flew south along the Adriatic coast". A little earlier the writer of the amusing 'fourth leader' referred to a meeting of the Society for the Preservation of the Fauna of the Empire at which the care of the opossum was discussed, comparing this with the report of happenings a hundred years earlier when there was a "humorous debate" at the Zoological Society "about puffing cigar-smoke into the cages of the monkeys", to their evident discomfort. The writer, yielding too far, we hope, to the depression of the present day, concludes: "The world, it may be, is 'man-sick' and yearning to be rid of a bad mistake. But the creature cannot be wholly vile when instead of torturing monkeys it takes thought for the opossum".

It would not be right to quote from a century-old report without speaking of all that is done and has been done during many years for the care and health of animals by the great London Society, and in doing this, for the education and happiness of our people. But the change of which I have spoken is most deeply impressed on those who remember, as many of us do, the misdirected hours in youth when birds were shot in our gardens and brick traps made to catch them. I feel sure that those who did these things are not essentially different from their children and grandchildren who have grown up in a kinder atmosphere.

I must not occupy more time on a subject which to some may seem inappropriate, but it is bound up with education in its true sense—a leading out—and if, as Ray Lankester said at York, and we are all coming to believe, the hidden powers within *are* inherited while the results of their development are *not*, then there is no easing of the burden with the passage of time, but each generation afresh must bear the heavy responsibility of conducting this development in the best way so that its successor may be able to meet the changing and, at this time, the increasing needs. The relationship between the powers within and their development was suggested in arresting words by the late Prof. Scott Holland: "To say that a man cannot be made good by Act of Parliament is such an obvious truth that people forget what an outrageous lie it is!"

INTERNATIONAL PEACE

Thoughts on the development of these hidden powers by the educating influence of social environment, suggest the greatest of the problems by which we are faced—the end of international war. Michael Foster, in his address at Dover in 1899, after speaking of progress in the material of warfare was led to believe that, "happily, the very greatness of the modern power of destruction is already becoming a bar to its use, and bids fair—may we hope before long?—wholly to put an end to it; in the words of Tacitus, though in another sense, the very preparations for war, through the character which science gives them, make for peace". In his concluding pages he expressed the hope that the brotherly meeting between the English and French Associations at Dover and Boulogne might be looked upon as a sign that science, by nobler means than the development of armaments, was steadily working towards the same great end. In a time of still greater need and perplexity, may we not, in the same hopeful spirit, look upon the recent visit by which members of the French Association have honoured us, and feel strengthened in the belief that the great end will be reached.

There are, I know, very many people who look upon the Great War with later wars and rumours of wars as the close of Michael Foster's dream. The words in which Sir Arthur Schuster concluded his address at Manchester in 1915, and Sir Edward Thorpe at Edinburgh in 1921, indicate, I hope, that the British Association does not thus despair, and in this belief I bring before you a passage from the far earlier address which Sir Richard Owen delivered to the twenty-eighth meeting at Leeds in 1858—a passage which makes a special appeal at a time when the British and American Associations are confidently hoping to strengthen still further the bonds of sympathy and mutual appreciation by which they have been happily united for so many years.

Referring to the trans-Atlantic telegraph, Sir Richard said:

"We may confidently hope that this and other applications of pure science will tend to abolish wars over the whole earth; so that men may come to look back upon the trial of battle between misunderstanding nations, as a sign of a past state of comparative barbarism; just as we look back from our present phase of civilization in England upon the old border warfare".

Confident words inspired by the forging of a new link between the two great English-speaking nations. Nearly eighty years have passed since they were spoken, but with all the terrible disappointments there has been great progress, and a time will surely come, and may it come quickly, a time which shall prove that the visions of the young and the dreams of the old were prophetic of a glorious reality.

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[1] "Early Science in Oxford", vols. 1–11.

[2] "The Natural History of Oxfordshire, being an Essay toward the Natural History of England", by Robert Plot, D.D. Printed at the Theater in Oxford. 1677. Dedicated To the most Sacred Majesty of Charles the Second, King of Great Britain, France and Ireland, Defender of the Faith, etc. (pp. 118–122).

[3] "Life and Letters", vol. 1, p. 157.

[4] Report, British Association, Centenary Meeting, 1931, p. 78.

[5] Report, British Association, 1905, pp. 514–518.

[6] Report, British Association, 1921, pp. 413–415.

[7] "Science and the Faith", London, 1889, pp. 222–235.

[8] "Life and Letters", 1900, vol. 2, p. 379.

[9] From a letter of August 10, 1894, printed in the *Jesus College (Oxford) Magazine*, for Lent Term, 1928; and reprinted in *Hope Reports*, vol. 16, 1929, No. 3, p. 6. (Privately circulated to many scientific libraries.) Huxley's letter of August 18, 1894, to Lewis Campbell ("Life and Letters", vol. 2, p. 379) refers to the same subject.

[10] The lines are quoted from the first part, published 1846–48.

[11] Darwin-Wallace Celebration of the Linnean Society of London, 1908, pp. 6, 7.

[12] "The Origin of Species. A New Song". In "Songs and verses, social and scientific", by an old contributor to Maga. Edinburgh, 1868, 2nd Ed.

[13] *Ibis*, October, 429–433 (1859).

[14] Report, British Association, 1906, pp. 26–27. The conclusions here quoted had been communicated to Société de Biologie of Paris in 1899 (Jubilee volume) and were reprinted in NATURE, **61**, 624–625, (1900).

[15] Report, British Association, 1895, p. 734.

[16] NATURE, **51**, 127 (1894); Report, British Association, 1906, pp. 29, 30.

[17] *Trans. Roy. Ent. Soc., Lond.*, **85**, 131 (1936).

[18] *Proc. Roy. Soc.*, B, **106**, 83, pl. v (1930); *Proc. Ent. Soc. Lond.*, **5**, 14 (1930).

[19] Report, British Association, 1931, p. 77 and references quoted.

[20] *J. Linn. Soc.* (Zool.), **26**, 465, pl. 30 (1898).

[21] "Evolution", A. Franklin Shull (New York, 1936).

[22] Walsh and Riley, *The American Entomologist*, St. Louis, Mo., 1, 189 (1869).

[23] *Trans. Linn. Soc. Lond.*, **23**, 495 (1862).

[24] Riley, "Third Annual Report on the Noxious . . . Insects of . . . Missouri" p. 142 (1871).

[25] Poulton, "Charles Darwin and the Theory of Natural Selection" p. 202 (1896).

Summaries of Addresses of Presidents of Sections[*]

Noise and the Nation

THE programme in Section A (Mathematical and Physical Science) this year is largely devoted to some of the social and industrial developments of applied physics. The president of the Section, Dr. G. W. C. Kaye, has broken with precedent in giving an address of an experimental character, and in choosing an acoustical subject for the first time in the history of the Section, extending over a hundred years.

Acoustics was long the Cinderella of the physical sciences, but with the coming of the gramophone, radio, broadcasting and the talking pictures, and the popularizing of the telephone, the commercial value of applied acoustics must now run into very large figures. Sound has become a marketable commodity, the cultural and political developments of which, particularly in regard to broadcasting, it is not easy to envisage. The literature is immense and the terminology large and extensive, as may be gathered from the recently published acoustical glossary of the British Standards Institution.

Simultaneously with these developments in applied acoustics, the nation has begun to take notice of the growth of noise—a by-product attributable in great part to an increasingly mechanized civilization. Much research is being carried out to meet the public demand for greater protection against the noise nuisance of to-day, chief interest being probably centred in the noises on the road and the noises experienced in modern buildings, which are admittedly not so quiet as those of a generation ago.

It is only within the last few years that practicable instruments have become available to measure and analyse sounds and noises, though it cannot be said that finality in these directions has been reached. In cases of annoyance caused by noise, experience indicates that while the composition and the psychological aspects are not to be ignored, sheer loudness is often a determining factor. Particular attention has therefore been devoted to the subjective scale of loudness and its unit, the phon, and the associated unit of energy or pressure level, the decibel. An important step was taken this year when both were adopted as international units by some thirteen nations in Paris.

The study of the general question of noise transmission, particularly in buildings, is more complex than might be imagined, and some of the major difficulties are not yet completely resolved. For the purpose, facilities such as are provided by the 'sound-proof' acoustic laboratories at the National Physical Laboratory have proved to be necessary. *Inter alia*, it already appears that special designs of double floors, double walls and double windows, which have been evolved, form material contributions to noise-abatement in buildings. The degree of public interest in the general question is illustrated by the wide variety of noise problems submitted to the National Physical Laboratory during the last few years: for example, the mitigation of the noises in aeroplane cabins and engine-testing factories, trains, ships, tube railways, motor-cars, motor-cycles, motor-buses, motor-horns, pneumatic drills, printing works, transformer sub-stations, cathedrals, assembly halls, business offices, flats, miniature rifle ranges, building operations and so on.

The growing volume of road traffic and the ever-increasing speed and acceleration of individual vehicles are major contributory factors to the problem of road transport noise. A Departmental Committee of the Ministry of Transport was appointed in 1934 and has since published three reports. Loudness measurements, many thousands in number, were conducted for the Committee by the National Physical Laboratory on the overall noise of some hundreds of motor-vehicles, both new and old. The Committee has proposed noise limits, which, while making very moderate demands on most types of vehicle would, by ruling out the flagrant offenders, help to ensure a standard of acoustical decency on the roads of Great Britain. More recently, the Committee has submitted a report on motor-horns.

Organized steps are being taken in Great Britain to further the abatement of the many types of unnecessary noise. There is now a goodly list of 'silent' appliances in everyday life, though it is evident that as regards many commercial machines and processes we shall have to put up with second-class expedients for the present. It is evident, however, that the finding of practicable solutions to the many ramifications of the noise problem would be welcomed by almost every section of the community.

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[*] The presidential address, and addresses by the sectional presidents, are being published as "The Advancement of Science, 1937" (Nottingham: B.A. Reception. London: Burlington House.) 3s. 6d.

Researches in Chemotherapy

CHEMOTHERAPY, which forms the subject of Dr. F. L. Pyman's presidential address before Section B (Chemistry), may be regarded as the treatment of disease by chemical substances, which have been shown by biological methods to be relatively much more toxic to pathogenic organisms than to human or other animal hosts.

Chemotherapy was developed by Paul Ehrlich, and its most outstanding achievement has been the introduction of the arsenic group of spirochæticides.

In the field of bactericides, the introduction of phenol as an antiseptic by Lister in 1867 has led to the study of many derivatives of phenol. Recently systematic studies of various homologous series of phenols have resulted in the introduction into medicine of hexyl-resorcinol and amyl-*m*-cresol, the latter having a Rideal-Walker coefficient of 280.

The chemotherapeutic investigation of amœbicides was greatly facilitated by the *in vitro* test for amœbicidal efficiency developed by Dobell and Laidlaw. Using this test, Coulthard studied a series of alkyl derivatives of harmol prepared in Messrs. Boots' laboratories and showed that peaks of bactericidal efficiency were reached at butylharmol for *B. typhosus* and at amylharmol for *S. aureus*, whilst peak amœbicidal activity was found in *O*-*n*-nonylharmol. Salts of members of this series were, however, very sparingly soluble in water, and in order to obtain more soluble compounds the corresponding dialkylamino derivatives were prepared and their amœbicidal activities compared with that of emetine. Although the most active member was not as active as emetine, it had several times the activity of *O*-*n*-nonylharmol and it was suspected that the harmol residue might not be the important contributor to the amœbicidal properties of the molecule and that the dialkylaminoalkyl group might play an important part. This led through various intermediate stages to the preparation and study of a series of tetra-alkyldiamino paraffins and of these *ακ*-tetra-*n*-amyldiaminodecane was found to be the most efficient. For brevity, the compound is referred to as T.A.D.D.

The preceding results had shown that, when tested by the Dobell and Laidlaw technique, T.A.D.D. was the most active amœbicide so far prepared. It now became necessary to compare the efficiency of this compound with that of emetine under conditions as similar as possible to those found in the intestine of a dysenteric patient. When tests were carried out under these conditions T.A.D.D. was found to be more active than emetine. As originally pointed out by Ehrlich, the therapeutic value of a substance is a function of its toxicity to both parasite and human host. It became necessary, therefore, to determine the relative toxicities of T.A.D.D. and emetine to mice. The results of such a test showed T.A.D.D. to be from one third to one eleventh as toxic as emetine, depending on the method of administration.

T.A.D.D. had thus a greater *in vitro* amœbicidal activity and was less toxic to mice than emetine. These results appeared to justify the clinical trial of the compound in the treatment of amœbic dysentery.

Such a trial was carried out by Prof. Warrington Yorke, at the request of the Therapeutic Trials Committee of the Medical Research Council. Unfortunately, T.A.D.D. proved to be too irritant for parenteral administration and it was not sufficiently active to be of any real value when given orally.

Whilst this investigation has not yielded a compound of clinical value, it has resulted in the accumulation of valuable data which will be of value in further work on this subject.

The account of such an investigation indicates the enormous amount of chemical and biological team work involved in attempts to evolve new drugs for the treatment of disease.

The Glaciation of the Midlands

IN his address to Section C (Geology), Prof. L. J. Wills discusses the Pleistocene history of the West Midlands with the object of discovering how many glaciations are represented, and of linking these up with the better-known sequences of East Anglia.

It has long been recognized that the boundary between the 'Newer' and 'Older' Drifts crosses the district from Church Stretton through Bridgnorth to Wolverhampton. Prof. Wills devotes attention mainly to the Older Drifts, which have undergone enormous denudation in the vales but have in varying degrees survived on the Midland Plateau and on watershed areas. The evidence of the former great extension of the present outcrops is scattered, but is *en masse* sufficient to allow the assumption that the vales of Severn and Avon were ice-filled during the older glaciations, though it must be realized that they were far shallower then than now.

In the Midlands three principal types of drift can be recognized: *Irish Sea* in the north-west, and belonging to the Newer Drifts; *Western* or *Welsh* on the Midland Plateau (this occasionally contains Irish Sea boulders, and in the Trent valley is *Pennine*, not Welsh, in origin); *Eastern* to the east of the Warwickshire Coalfield and in the Avon vale as far down as Stratford and possibly as far as Tewkesbury. The Eastern Drift is a continuation of the Great Chalky Boulder Clay of the Eastern Midlands and East Anglia.

Analysis of all the available evidence leads to the conclusion that the Older Drifts of the Midlands are the products of two separate cold periods. In the First Glaciation, ice moving from the north-west brought Welsh and Pennine material. The Welsh lobe travelled down the Severn vale, and its marginal drainage was probably responsible for the siting of the present Lower Severn valley. Some evidence of the First Interglacial has been obtained near Coventry and Rugby, and in Leicestershire. In the Second Glaciation the 'Great Eastern Glacier' of Harmer was the dominant feature, but side by side with it was an important Welsh Ice Sheet covering the northern part of the Severn vale and much of the Midland Plateau. The influence of these two lobes can be seen in the distribution of glacial and river drifts, and in modifications of the drainage. The retreat stages of the two ice sheets can only be traced in very general outline; the indistinctness is a measure of the antiquity of the events.

The Second or Great Interglacial which closed the period of the Older Drifts and led up to that of the Newer, is represented in the Midlands in two ways: first, by vast denudation which allows us to designate the Older Drifts as 'high-level' in contrast to the 'low-level' terraces of the valleys that resulted from the erosion; and secondly, by the Kidderminster Terrace of the Severn and No. 4 Terrace of the Avon, the distribution of which makes it improbable that ice has since invaded the Midlands beyond the limits of the Irish Sea Drifts.

The Third Glaciation is represented in the north-west by the Irish Sea Drifts, and elsewhere by the Main Terrace of the Severn and its correlatives in all the tributaries, and by taele-gravels and melt-water flood-gravels. Only brief reference is made to the outstanding influence of this glaciation on Midland physiography through the establishment of the Iron Bridge diversion of the upper Severn with the resultant rejuvenation of the river due to its increased volume. This and the evidence for a fourth glacial episode can only be touched upon; and no attempt is made to deal with the latest events, the primary object being to establish the existence of two glaciations within the period of the Older Drifts, and the correlation of the second of these with the Great Eastern Glaciation of East Anglia.

Selective Action of Mortality

FOR the reasons that they furnish reliable information concerning the progress of a vast experiment which we are conducting with ourselves as the experimental material, and also that they can be appreciated only by such as can bring to their examination knowledge derived from a comparative study of different forms, wild and domesticated, in the open and under the conditions of controlled experimentation, the attention of the zoologist is directed by Prof. F. A. E. Crew in his presidential address to Section D (Zoology) to the facts and observations relating to the human sex ratio.

It is easily demonstrated that to be born is a far more dangerous adventure for the male than for the female, and that indeed the true recipe for longevity is to be born a girl. It is equally readily shown that numerical equality of the sexes in a population such as ours exists only among those individuals who belong to the ages that are associated with the reproductive prime. Among the 0–15 year olds there are more males than females. Among the 20's and over there are more females than males, and the female numerical preponderance increases with increasing age, so that among the 85's and over there are twice as many women as men. In a democracy such as ours, in which sex is supposed to be disregarded, the political power of women is not at all commensurate with their relative numerical strength.

This swing in the sex ratio from high to very low is known to be the result of a sexually selective mortality which operates to the disadvantage of the male both before and after birth, and since the severity of this mortality is profoundly influenced by a number of environmental agencies, it is possible to use the sex ratio as a measure by which a society may assess the quality of its architecture.

It can be shown that there is nothing unique about the human sex ratio, and that the forces which tend to distort it are identical with those that produce the same results in other forms. When male is contrasted with female, it becomes clear that the greater fragility of the former may be regarded as an indication of his relative lack of importance in respect of propagation. Efficiency and economy would seem to be observed by the removal of the male when he has served his purpose. Through selection the sex ratio can become adjusted to the conditions that exist in a population, and it is possible to construct a thought model of a purely genetic mechanism through the workings of which the size of the primary sex ratio is brought into harmony with the amount of mortality due to the action of sex-linked genetic lethals, to sex-limitation in the expression of disadvantageous characters, and to the effects of sex dimorphic physiological qualities. The relation between the size of the primary sex ratio and the amount of mortality, both pre-natal and during adolescence, is such as to lead to the establishment of an optimum reproductive sex ratio among those who, in respect of purely biological properties, are newly equipped for ardent reproduction.

Changing Distribution of Population

IN noting that four chief populous regions, in 'Europe', the Far East, India and eastern North America, now contain three fourths of mankind on one eighth of the land area of the world, it is pointed out by Prof. C. B. Fawcett in his presidential address to Section E (Geography), that the peopling of the fourth of these by the great European migration of the last two hundred years is the only shift of population of world magnitude recorded within the historic period. The south temperate lands even now contain barely a fortieth of the world's population; and the other considerable migrations are merely oscillations of the margins of the four great populous regions.

A more important change is the recent growth of great conurbations. In 1801 London, with 950,000 inhabitants, was the only city which approached a million. Now there are about sixty million-cities, a dozen of which exceed five million, and which together include a twelfth of mankind. The number and population of these great conurbations are growing; and if this trend were to continue unchecked for another two or three generations, it would give a world in which a majority of the inhabitants would dwell in two or three hundred such cities.

Within the great populous areas there is also a development of a few small areas of maximum concentration, where great conurbations tend to cluster. Three such areas are noted. The chief is in Western Europe. Part is in England, where it stretches across country from South Lancashire and West Yorkshire to Essex and Sussex and gives this belt of country a mean density of three thousand persons per square mile. It is continued beyond the Strait of Dover to the Rhineland. A second such area, of similar extent but half as populous, lies along the coast of the Middle Atlantic States of the United States of America, where a fifth of the population dwells on a hundredth of the area of the country in an urban zone from Boston to Washington. A third is appearing along the lower Yangtze in China. There is as yet no comparable development in India.

Somewhat more recent in its development is the widespread retreat of population from 'regions of difficulty', marked by the diminution of population in all the highland areas of Britain and Europe and in the semi-arid parts of Australia and North America. Both changes are ascribed mainly to improvements in agricultural science and in transport, which make the cultivation of such marginal lands both less necessary and less attractive. This change is aided by the check to the natural growth of population in all the lands of Western civilization; for the rapid increase in numbers which has been a dominant fact of human life during the past two hundred years, during which mankind has increased from about 500 millions to some 2,000 millions, is now coming to an end. But there is as yet no indication that this check to growth is affecting the trends of movements discussed, which result from the development of applied science.

Economic Research and Industrial Policy

THE rationalization and planning movements, unofficial and official, that have in recent years swept over the industrial world involve a number of practical policies that must be separately discussed if their efficiency is to be scientifically assessed. In his presidential address to Section F (Economic Science and Statistics), Prof. P. Sargant Florence reviews recent realistic research into the policies of the siting, size and scope of industries.

A policy of siting or location has been urged upon the Government in connexion with the redevelopment of the depressed areas. Economic research has had to devise methods of measuring the degree of localization of all industries in the various regions of England and Wales and is now nearer a position to specify what industries can be developed where employment is still stagnant. In general, the extreme localization of industries at the source of fuel or of the existing supplies of skilled labour seems to have reached a limit, and the proximity to the home market to have become relatively more important.

A policy of larger-sized plants, firms or areas of control is usually implied by rationalization and planning. Recent statistical research into prevailing sizes, the trend in sizes, and comparative profits and costs in Britain, Germany and the United States does not confirm the theory that limits to size have been reached owing to organization becoming unmanageable. Size, however, varies characteristically with different industries, and depends largely on their degree of mechanization and localization. A particularly pressing problem is the large number and the small size of middlemen and shops in the distributive trades. The lack of any official census of distribution for Britain makes calculations difficult, but it seems probable that there is one retailer for about every ten families, and, even for single commodities like tobacco or confectionery, an outlet for every twenty to thirty-five families! This appears excessive, since the smaller the sales turnover of each retailer the more profit he must charge per unit of sales to obtain a given income for himself. This raises prices and leads, in a vicious circle, to yet lower turnover.

Policies involving the scope of industry are those 'integrating' various processes, products or services under the control of one organization, or specializing upon and standardizing certain varieties. Standardization, as against integration, allows of mass production and of possibilities of increasing returns. There are difficulties in measuring and comparing the scope of plants or firms, but several recent experiments in connexion with plans of rationalization have shown the great increase in efficiency that specialization and narrowing of scope may achieve within one plant.

Policies of site, size and scope are interrelated. Large size is more manageable if of narrow scope, but difficult if sites must be scattered among the consuming population owing to the intransportability or the servicing requirements of the product. Further research along realistic and statistical lines is urgently needed if public policy or the policy of private firms is to achieve greater efficiency and save wastes of materials, mechanical power and man-power.

Research in Engineering

IN his presidential address to Section G (Engineering) Sir Alexander Gibb deals with the importance of research in the history of engineering. Recognition of this fact has been of very slow growth.

Organized research was nearly unknown until the end of the nineteenth century. Early progress was due almost entirely to individuals and learned societies, such as the Royal Society, working often in an atmosphere of public ridicule. Though the British led the way in Government recognition about the middle of the nineteenth century, it was largely due to the German example after the Franco-German War that the true value of research to the nation and industry was realised. The Reichsanstalt and other testing laboratories had a direct effect on British policy which showed itself in the setting up of the National Physical Laboratory in 1900, leading later to the Department of Scientific and Industrial Research, which is now the focus, linking together all research going on in Great Britain.

The year 1900 is a boundary mark in the history of research in Great Britain. The National Physical Laboratory (1899) and the Engineering Standards Association (1901) were born then. The first, with the Department of Scientific and Industrial Research, of which it became a part in 1918, has grown into a body employing a staff of more than 1900 scientific workers; while the Engineering Standards Association has become an immense organization of no fewer than 870 committees with 4850 members.

Engineering, which started as an art, is now an applied science; and we look on scientific and industrial research as an essential factor in our national existence. In one generation our attitude has completely changed, from individualistic effort to co-operation and co-ordination. To-day national research departments, industrial research laboratories belonging to great firms or industries, research associations, scientific institutions and universities and technical colleges are the chief agencies which carry out the work, often in close co-operation one with another.

In the United States, the Dominions, and on the Continent progress and development have been equally revolutionary; and more so in some of the totalitarian States, where all research is centralized under State control. In Great Britain, though co-ordination and co-operation have done much to link together the various elements, we still lack a general national plan. Some form of affiliation to a central controlling body is inevitable if we are to avoid overlapping and duplication with their attendant waste of energy, time and money. This, incidentally, is especially necessary where the publication of the results is concerned. At present these are scattered in far too many different periodicals. A central clearing-house for engineering information is an urgent need.

One note of warning is sounded by Sir Alexander. The effects of research may sometimes be too sudden and revolutionary. Obsolescence may be too rapid, and vested interests may be tempted to buy up and suppress new inventions in order to save the loss their exploitation may involve to already operating plant. It would, however, be a short-sighted policy to restrict our enthusiasm for these reasons. He is satisfied that at the moment in the engineering world there are two outstanding questions, the co-ordination of effort and the promotion of intensive research.

Assam Origins in Relation to Oceania

DR. J. H. HUTTON in his presidential address to Section H (Anthropology) deals with certain aspects of the culture of the Assam hills which suggest a close association in origin with those of Oceania, and which may therefore throw some light on the general problem of the succession of cultures in the Indonesian archipelago.

The link between the cultures of the Naga Hills and of Melanesia has been brought into prominence by recent work of Prof. Henry Balfour, while the work of Dr. A. C. Haddon and others in Borneo and New Guinea affords instances enough to show a line of related cultures connecting Assam with the islands of the Pacific. To determine, however, the nature of that relation, it is advisable to concentrate on particular areas, and for this purpose the Fiji Islands, the Marquesas and Madagascar are chosen as being three widely separated points with inhabitants of varied race and culture in the Oceanic area.

In the case of the Fiji Islands, parallels with Assam are indicated in practices connected with war, head-hunting and human sacrifice, with the cult of the dead, and with beliefs in regard to the soul, and in items of material culture, in particular in regard to the Fijian national game of *veitingga*, and in some psychological aspects. In the Marquesas Islands a similar series of parallel customs is found, particularly in the practices associated with head-hunting; for example, in the separate disposal of the mandible and in the use of stone. In Madagascar a rather different parallel complex is found, though here again there is much similarity in the use of stone and in the treatment of the dead.

An important feature of Naga culture is the use by certain tribes of slit wooden gongs or xylophones. The cult associated with these gongs is in many ways closely parallel to canoe cults of Melanesia, and it is suggested that the Naga "canoe-gong" is a dug-out canoe by origin which has survived, as a musical instrument and a fertility fetish, a change of environment which inhibited its use as a canoe. The intimate association of the canoe-gong with head-hunting is particularly noticeable, as the ceremonial is very similar to that associated with the canoe in Melanesia, the main difference being that in the latter case the association is natural, since the canoe is the means of obtaining the victim, whereas in the Naga Hills there seems no direct reason for associating the "canoe-gong" so closely with the taking of heads. Further, the canoe can be, and is, used as a gong for certain purposes in the Pacific, where it is sounded by means of the handles of the crew's paddles. A somewhat similar practice is found in Manipur, and it is suggested that the dumbbell-like implement used for pounding on the sides of a canoe-gong is a degenerate form of a paddle formerly used for propelling it as well.

The general conclusion is that not only has the culture of Assam been influenced by a stream of migration from Indonesia north-westwards, but also that in both areas, as in Oceania, a series of corresponding and related cultural strata are to be found in an amalgamated form, even if the actual site of amalgamation was elsewhere. It is suggested that such a site is to be sought for in or near the Indian archipelago.

Heat Production, Nutrition and Growth in Man

IT is almost a truism to say that the amount of money spent on medical research has greatly increased of recent years; but, as Dr. E. P. Poulton shows in his presidential address to Section I (Physiology), the application of research to medical practice has lagged behind, especially where newer and expensive apparatus is concerned, largely because of the straitened circumstances of the voluntary hospitals. A pious benefactor could accomplish much with a comparatively small sum of money if he helped the voluntary teaching hospitals in this respect, as when once the medical student—the future doctor—has become accustomed to a new method or new apparatus its spread through the country cannot be so long delayed.

Direct calorimetry means the determination of the heat in a calorimeter. Indirect calorimetry means its calculation from the oxygen absorbed and the carbon dioxide given out. At present indirect calorimetry is based on the theory that the respiratory quotient (volume of carbon dioxide given out divided by volume of oxygen absorbed) indicates the proportion of fat and carbohydrates being burnt in the organism. A comparison of the figures for heat, oxygen and carbon dioxide obtained by Benedict and Carpenter and Du Bois and his colleagues, shows that there is a fundamental error in the present method of indirect calorimetry.

The theory which best explains the facts is that carbohydrate and fat are always burnt in a fixed proportion in the organism, and that when the respiratory quotient rises there is simultaneous conversion of carbohydrate into fat, and with a fall of respiratory quotient vice versa, as indicated by the following equation, which is based on Cathcart and Cuthbertson's analyses for human fat, and from which it follows that every litre of oxygen used in the conversion is equivalent to 3·93 calories :

$$4C_{27}H_{50}O_4 + 42O_2 \rightleftarrows 18C_6H_{10}O_5 + 10H_2O.$$

A quantitative proof of this conversion (1) during basal metabolism tests, (2) after food and (3) during exercise on a carbohydrate diet is obtained from the fact that, after allowing for the heat, oxygen and carbon dioxide required for the combustion of carbohydrate and fat in a fixed proportion, the equivalence of the remaining oxygen and heat is very close to this figure.

Since these conversions are ephemeral under basal conditions, the basal metabolism should be measured by the carbon dioxide alone, and this means a new definition of basal metabolism ; an experimental method is described. It is argued that the proper standards of metabolism in adults depend on the weight and age of the individual, and that the height should not be brought in as a separate factor, as in Du Bois's height–weight formula. In babies, however, height is more important than weight, because some individuals are heavy, probably from the retention of fluid due to hypothyroidism. There are three nutritional periods in childhood : the first, up to a length of 29 inches (1 year), when the baby puts on fat and the carbon dioxide increases rapidly ; the second, from 29 inches to 41½ inches (5–6 years), when the excess of fat is lost and the metabolism only increases slightly with the weight ; and the third, from 41½ inches upwards, when the weight and carbon dioxide increases steadily. It is shown that the relation weight to age is not a satisfactory standard of growth ; but only height and age, the 'cumulative growth curve'. Although growth is greater now than it was fifty-six years ago, and children of better-class families are taller than those from poor families, the average general nutrition of the child in these groups, represented by the relation of the logarithm of the height to the logarithm of the weight, remains constant, and it is suggested that the calorie intake is sufficient ; but that certain growth factors are deficient among the poorer classes.

Tests for Colour Defects

DR. MARY COLLINS in her presidential address to Section J (Psychology) discusses some of the tests used in the diagnosis of colour defect. A brief reference is made to total colour-blindness and blue-yellow blindness, but they have neither the same theoretical nor practical importance of the third form of the defect, namely, red-green blindness. The incidence of this latter type in the male population is quoted in recent literature at figures ranging generally from 5 per cent to 12 per cent, as contrasted with the figures usually given of 3–4 per cent, her own results giving 7·5 per cent. It does not necessarily follow that the incidence of the defect is increasing, but the indications are that the detection of the defect is now more accurate owing to the improvement of test material.

It is gradually being realized that many degrees of red-green colour-blindness exist. In its extreme form there is complete blindness to red and green, but in a milder form blindness to these two colours is only partial. Red and green can be discriminated if conditions are favourable, but when unfavourable conditions exist, as in mist or fog, these colours are confused. The anomalous trichromate forms one type of the partial colour-blind. The suggestion is made that provided the colour perception so far as red and green are concerned of a sufficient number of individuals could be examined, a continuous series ranging from normal, that is, perfect perception of these colours, to extreme red-green colour-blindness might be found. The intermediate forms, which although not totally blind to red and green show great deviations from the normal, are very important.

Tests for colour defect fall into two categories ; in one type of test, transmitted light is used, in the other reflected light. While the former is regarded as the more fundamental, the latter can be of great service for quick diagnosis of colour anomaly. As a spectrometric examination is not always possible, either some form of lantern test or pigment test is substituted. Both are essential in posts where lack of accurate colour discrimination involves danger to the community. The former, using coloured lights, brings conditions nearer to practical conditions. In other posts, however, a pigment test is all that is essential. To this end, a combination of the Ishihara test, the first three tables of the Stilling test and Schaaff's mosaic plates is recommended.

A detailed examination of a number of pigment tests has been made. The responses of a group of colour-blinds have been compared with the responses of a control group of individuals with normal colour vision. In this way an evaluation of the tests has been made possible. Some of the tests, too, have been submitted to filter analysis.

Inconsistencies have appeared. It may be that the discrepancies revealed are due to numerous deviations from the normal in colour vision, and that we are not dealing with linear variations in degree, but with multidimensional variations. A wide new field for investigation is thus disclosed, the working of which may yield valuable results for the whole theory of colour vision.

Education and the Modern Study of Plants

THE subject of Prof. E. J. Salisbury's presidential address to Section K (Botany) is the modern study of plants in relation to education. There are several misconceptions with respect both to the contacts and to the contents of botanical science. Despite the vastly enlarged content of botanical knowledge since it was regarded as a harmless and elegant occupation for the female sex, the general conception of botany has remained much what it was then. The high value of botany as an educational subject and indeed its absolute necessity in any system of real cultural development is an aspect that botanists have failed to present and emphasize. This is partly the outcome of the growing obtrusion of the more technological aspects in this as in other subjects ; a trend which is making itself felt further and further back in the student's training, at the expense of general education and culture. Here, as elsewhere, too much attention is paid to the acquisition of mere information, too little to the principles which are involved.

Our educational methods are too often divided in their allegiance between the provision of a liberal culture that will make for the greatest happiness of the individual in terms of mental contentment and an abiding resource in later life, and the technical equipment of the student for the earning of his daily bread. This emphasis on erudition has been perhaps encouraged by the universities through the fact that a sufficiently broad basis of scientific knowledge is not insisted upon before specialization begins, and that in the appointment to academic posts too little attention is given to capacity as teachers.

The merits of botany from the cultural point of view are many. It provides perhaps the best medium for training in accurate observation, it is the foundation of a vast extent of human activity and the basis of a large and essential part of every human environment. Its very extent, however, as indicated by enumeration of its diverse branches of taxonomy, morphology, anatomy, cytology, mycology, paleobotany and plant geography, on the descriptive side, and the experimental aspects of ecology, physiology, bacteriology and genetics, indicate the breadth of the botanical field, whilst the applied aspects of agriculture, horticulture, pomology, sylviculture and plant pathology show the great contribution that botany can make to the well-being of the human race as well as to the enrichment of the mind. This diversity tends towards detachment of interests and specialization which should be accompanied by greater co-ordination. The accumulation of data in these varied directions of inquiry will only fulfil its purpose if the many threads are continually woven into a single fabric of knowledge.

Herein lies the particular cultural value of the synthetic approach which we term ecology. The study of the plant in relation to its environment not only brings together almost every aspect of plant study but also has a direct bearing upon many practical problems such as land utilization, the conservation of water supplies, or the selection and care of national parks.

The Informative Content of Education

MR. H. G. WELLS, in his presidential address to Section L (Education), directs attention to an aspect of educational science that has received perhaps a disproportionately small amount of attention in educational literature, the question of information. He leaves the physical and mental training of our modern populations aside, he contributes nothing to the discussion of language teaching, mathematics, the cultivation of literary appreciation, music, drawing and æsthetic training generally, and he concentrates upon the question of what a modern human being should know in order to play the part of a citizen, happily and adequately. What sort of *fact system* should be and can be established in a normal human mind under the conditions existing in a contemporary civilized community ?

Few people realize the restrictions set to the accumulation of knowledge by the exigencies of the time-table and the school-leaving age. When due allowance has been made for the other elements in educational work it is questionable whether we can allot more than six hours a week to imparting real knowledge (real, that is, as distinguished from methods of expression, etc.), or, assuming ten 40-week years, rather less than two thousand four hundred hours altogether in the school period of life. A vast amount of miscellaneous knowledge is, of course, picked up by talking, reading, observation and so forth outside the formal school scheme and we learn facts in vast variety to our dying days, but this is uncorrelated stuff, and it is within the limits of these two thousand four hundred precious hours that a sound framework of general knowledge must be established, if ever it is to be established in the growing mind.

At present we waste a considerable amount of this meagre allowance in imparting useless and unedifying information or information of secondary importance. We need a much more stringent economy in this respect and a more rigorous examination of what is included. The desire for knowledge, unless it is perverted and discouraged, is a natural impulse in the developing human being, and the informative side of educational work should be based on the natural curiosity of the child and should stimulate, develop and gratify it. The curiosity of the child turns mainly upon inanimate things and what can be done with them, upon animals and (secondarily) plants and upon personal and then social reactions. Upon the systematic exploitation of these primitive divisions of curiosity our teaching of the facts of physics, biology and historical and social sciences must rest. By a careful selection of topics it is possible in the period up to the dawn of adolescence to impart clear conceptions of material science, making for mechanical understanding and competence, and a vision of the history of life upon the earth and of human history and human conditions, hygienic, physiological, geographical and political, sufficient for adequate citizenship without any killing of the spirit of inquiry.

A much more realistic and serviceable knowledge than is generally attained, of economic life and of the legal conventions of property and of the process of finance which dominate our everyday lives, is possible before the school-leaving age, but it is possible only through the stringent elimination of any irrelevant matter and of any matter which distorts the general picture. The major fault of the knowledge system we build up to-day in the general mind is its lack of proportion. The historical intelligence, the political mind of the contemporary European citizen is a sort of hunchback mind, in which the hole-and-corner facts of the national history and the petty details of the Jewish tribal records loom, preposterously exaggerated. The necessity of a drastic modernization of the historical outlook has been shirked too long—with disastrous results to the world. History, the backbone of our fact system, needs to be straightened and that hunch removed.

Under modern conditions schooling is only foundation work. There is now no end to education throughout life. The primary fact system passes insensibly into a vast variety of technical learning and adult culture and so upward at its highest levels to the knowledge evoked by original inquiry and creative work. The proportion of those who contribute by observation and criticism to the common stock of knowledge and to its sifting and organization is likely to increase very considerably in the future. Mass observation as it is being developed by Harrison and his group may have many important effects upon the public mentality.

State Intervention in Agriculture

IN his presidential address to Section M (Agriculture), Mr. J. M. Caie first shows the position occupied by agriculture in the State, by giving statistics of areas, holdings and populations, the output of food from our farms, and the contribution they make to the food consumption of the people. Corresponding figures for Denmark and Norway are given for purposes of comparison. Specially notable facts are that the number of persons per acre of cultivated land in Great Britain, 1·5, is relatively high, while the proportion of the population engaged in British agriculture, about 6 per cent, is very low, as compared with 29 and 30 per cent in the other two countries; that the products of animal husbandry represent about 72 per cent of the output of our land; that the value of the output per acre of land is about £8 in Great Britain and Norway, and £11 in Denmark, while the annual output per person in British agriculture is £200 and in Danish £150; that in respect of most products, except liquid milk, oats and potatoes, we require to import very considerable quantities; and that agriculture buys from other industries goods valued, roughly, at twenty to thirty million pounds a year.

State intervention may be divided into three categories: (1) compulsion, enforced by penalties; (2) provision of means for voluntary action, with powers to compel minorities; (3) assistance—financial, advisory, protective, etc. Present measures of control are such as relate to annual statistical returns, contagious diseases of animals, destructive insects and pests, live-stock breeding, agricultural wages, etc. Under the second category comes the recent marketing legislation, while under the third category particular mention may be made of State grants for agricultural education and research. In 1912 these amounted to £100,639 per annum, whereas in 1936 the corresponding figure was £765,339. During that period the only significant increases in the average yield per acre of our principal crops were about 4–5 bushels of oats and half a ton of potatoes. But many progressive farmers could show increases in excess of the general average, and the effects of improved methods are also to be found in reduced costs of production.

Statistics suggest that British agriculture at present falls short of producing as much home-grown food as is possible and desirable for the nutrition of the people and of affording employment on the land to as many persons as is reasonably practicable. As the output per unit of agricultural labour is steadily rising, increased production may not necessarily cause increased employment, but on the other hand it will probably be long ere the large-scale mechanized farm is normal in Great Britain. Two million acres have gone out of arable cultivation since the Great War, and increased production is at present a question of making up leeway in land and people rather than of settling men on new holdings.

The amount of assistance afforded by the State to agriculture indicates a possibility that, sooner or later, greater control may be exercised over the farmer's methods and the quantity and quality of his products. Such measures might raise questions as to insurance against loss, limitation of profits, control of rent, wages, etc. If it were the permanent policy of the State to support agriculture, it might be desirable to survey the whole industry, its place in the social and economic structure of the country, its present and potential capacity to meet the food requirements of the people, and its relation to international trade.

Lastly, one must consider whether in State aid, with its attendant shadow of control, lies the only hope for British agriculture. Some, at any rate, would wish to believe that our farmers, given a fair share of the home markets, could maintain their position by their own initiative, energy and resource, and with the help that education and research, both scientific and economic, can give. Otherwise there is at least a risk that our farming may become a hanger-on of the State, dependent on its bounty and subject to its commands.

Natural History Outlook

THE natural history outlook has changed so much during the present century that a new orientation is required if natural history societies are to keep their place as an integral part of the organization of science in Great Britain. In his presidential address to the Conference of Delegates of Corresponding Societies, Prof. James Ritchie directs attention to the changes which specialization has wrought in the opportunity of original amateur investigation, and suggests ways in which the societies might turn modern trends to good account.

Local societies perform useful work in spreading knowledge of scientific method and progress by their lecture programmes and discussions, but a higher aim is the gaining of new knowledge by regional investigations. The stable work which until now has kept the societies alive as contributors to science has been the building up of local lists. That outlet for the energy and enthusiasm of the local naturalist has become restricted owing partly to the exhaustion of opportunity for discovering rarities, and partly to the increasing subtlety of identification demanded by the modern systematist, so that the amateur has been frozen out of a province which for ages was particularly his own.

Two notable developments in the natural history outlook of the present century suggest ways in which the natural history societies may still retain their usefulness and contribute their quota to the advancement of knowledge.

In the first place, there is a marked tendency, due to the complexity of scientific problems, to forsake the individualistic form of research and to replace isolation by the collaboration of many workers organized as a team, whose joint labours converge upon some definite problem. In the second place, the emphasis of research has moved from morphological studies, which have passed far beyond the scope of the amateur, to the investigation of the animal as a living thing. A combination of these two tendencies offers a new outlook and a new field for the societies, the combination of organized co-operation or team-work directed towards the solution of biological problems. Much has already been learned by such methods, for example, about bird migration by organized co-operation in the ringing of birds in Great Britain and other countries, about the arrival and movements of birds and many other seasonal occurrences by the organized reports sent to the Royal Meteorological Society and published annually as a Phenological Report, about the migration of insects by the records sent to a committee of the South-eastern Union of Scientific Societies. Members of the societies, as individuals, already do good work in all these investigations, but more observers are required, and the societies could organize them, and could add enormously to the scope and scientific value of the inquiries of such organizations as the Bureau of Animal Population at Oxford or the Institute of Ornithology.

Should some societies lack in numbers of naturalists able to engage in such joint enterprises in biological problems, there are many other opportunities open to the individual naturalist for the study of biological questions of real importance. Very little is known about the influence of weather and food supplies in Nature upon the development of mammals, birds, insects or, indeed, any other creature, and such studies, or the investigation of plant and animal populations in a circumscribed area, or of the changes wrought upon plant and animal groups by the interference of man, offer themselves as subjects for direct and not too difficult attack.

A third line of inquiry suitable for the amateur naturalist lies in simple experimental zoology, exemplified by such as Darwin's tests for the intelligence of earthworms, or Lord Avebury's experiments with bees and colours, or in more modern method Miss Ilse's experiments upon the colour preferences of butterflies.

Such investigations as have been suggested may not result in great discoveries—great discoveries lie in the lap of the gods—but for the observer they mean a training in accuracy, persistent or continuous observation, careful recording, and in the end that rigid consideration which leads from facts to general truths. To the societies, the natural history outlook will bring new vigour, and with it that satisfaction and honest pride which go with the enlarging, even in modest degree, of the bounds of knowledge.

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Britain. He points out that the basic unit in British local administration is the parish, the zone of influence of a single place of worship in the Middle Ages. Rural districts, urban districts and boroughs have been built up by the aggregation of parishes, and national parliamentary representation is still organized on that fundamental unit. As a consequence, in spite of many reforms, there are still more than two thousand separate authorities responsible for local community organization. Early legislation favoured supply by a local council. This favoured the setting up of a large number of small generating stations. The work of Ferranti showed the possibilities of alternating current transmission; but the small areas resulting from the early legislation, the wide distribution of coal and its abundant supply did not give the incentive to A.C. supply that there was in other countries. In 1925, a Government committee was set up under the chairmanship of Lord Weir. The committee came to the conclusion that there was a wide difference between generation and distribution and that retail distribution was a local matter which might suitably be decentralized. The findings of this committee were the basis of the Electricity Act of 1926. A Central Electricity Board was formed to construct and operate a large number of high-tension transmission lines called a Grid. The board divided the network into nine schemes covering the whole of Great Britain except northern Scotland. Not only did the construction of the Grid have a beneficial effect upon national employment at a time of acute depression, but also the experience in high-voltage construction which it entailed has placed British manufacturers once more in the forefront of technical progress.

University's Care of Body and Mind

RENSSELAER POLYTECHNIC INSTITUTE, founded in 1824 at Troy, New York, claims to be the oldest institution of higher learning in any English-speaking country that has devoted itself continuously to instruction and research in science and engineering. In a recent bulletin, it directs attention to the very thorough provision it has made not merely for the technical efficiency of its graduates but also for ensuring the physical fitness and bodily vigour of its undergraduates and for developing in them a broad and balanced mental outlook. Applicants for admission are examined physically; and if corrective exercises seem advisable they are prescribed by the Department of Physical Education. Every undergraduate is required to take during the first year a comprehensive course in physical education, including personal hygiene, recreational games, gymnastics, swimming and athletics. Medical advice and hospital care in case of need have been made available for all students. A member of the staff of a neighbouring hospital is in attendance daily for an hour and a half in the gymnasium for consultation. In the first year every undergraduate has to qualify in English, drawing, history, graphics, mathematics, physics and chemistry, and has to prepare a thesis during the summer vacation. The English course covers the material and methods of composition as illustrated by the successive steps in the preparation of a comprehensive article on a subject of immediate interest, the preparation and delivery of incidental speeches and a survey of contemporary ideas and current usages. Except in the case of students of architecture, all undergraduates also take a brief course introductory to professional study, designed to acquaint them with the materials and methods of study in different fields, to introduce them to the members of the faculty whom they will eventually meet in their work, and to indicate the nature of the openings which will be available to them upon graduation.

Natural History and Science in South Australia

THE presidential address before the Royal Society of South Australia, delivered by Dr. C. T. Madigan last year, is devoted to the history of the hundred years of science in South Australia as appropriate to this centenary year (*Trans. Proc. Roy. Soc. S. Australia*, 60, Dec. 1936). He points out that the Royal Society is really older than the State itself, for though it has an unbroken existence only since 1853, its origin can be traced back to the South Australian Literary and Scientific Association initiated among the founders of the Colony in London in 1834. The active functioning of the Royal Society dates from the inspiring presidency of Prof. Ralph Tate; in the twenty-five years of his association with the Society between 1876 and 1901, it became the established medium for publication of original scientific contributions. The nature of this published work is summarized by Prof. Harvey Johnston for general zoology, by Sir Douglas Mawson on geology, by Prof. J. G. Wood and Mr. J. M. Black on botany, by Dr. James Davidson on entomology, and Dr. T. D. Campbell on anthropology. Naturally these descriptive and natural history subjects, so important in a young colony, bulk most largely in this first century, and Prof. R. W. Chapman's report, whilst reminding us that many of Sir William Bragg's first publications in physics appeared in the *Transactions* of the Society, makes it most abundantly clear why this state of affairs prevailed. Before the Society or its predecessor, the Adelaide Philosophical Society, could spend its energies upon the publication of natural history, it had to pass through a phase in which it was the public forum for the advocacy of any and every cause associated with general education. In those days, even so late as 1868, a speaker urging the establishment of free schools, could quote a South Australian parent in this strain, "I have ten children who can't read or write. I can't read or write myself, why should they?"

Zoology of Iceland

THE study of the zoology of Iceland has lagged behind the investigation of its geology and geography, but a new work in five volumes on the "Zoology of Iceland" should form a worthy contribution to the knowledge of a fauna of unusual interest from several points of view (Copenhagen and Reykjavik: Levin and Munksgaard). The work will be carried out by specialists, and each part will appear as it is completed, so that publication will be discontinuous and will probably cover a period of about ten years. To subscribers parts will be sold at Kr. 1·00 per sheet, and the whole work is estimated to contain about 100–150 sheets. The two parts first to be published have been received—R. Spärck on "The Benthonic Animal Communities of the Coastal Waters", and E. Wesenberg-Lund on "Gephyrea". Both authors find that the fauna with which they deal consists mainly of an arctic and an arctic-boreal admixture, in which the latter predominates, and with which rare forms, such as the gephyrean *Sipunculus norvegicus*, represent a southern fauna which may have survived from a warmer period. In summing up the conclusions of his investigation, Spärck points out that the absence of a boreal shallow-water fauna seems to indicate that in post-glacial time no land connexion can have existed between Iceland, the Faroes and the continent of Europe. But the fauna itself is by no means a sparse one, since in quantity it compares favourably with the fauna of the North Sea, which is generally considered to be very productive and is richer than the corresponding faunas of East Greenland and northern Russia. This relative wealth of bottom fauna may be a dominant factor in determining the presence of a fish population, which in turn has determined the importance of the fisheries in Iceland waters.

Plants and the Dwelling-House

Most people readily admit the value of cut blooms and growing plants for decoration of the home, but not all plants can make good growth in the somewhat trying conditions of the average dwelling-house. A recent publication of the Field Museum of Natural History, Chicago, is entitled "House Plants" (No. 20, 1937, 35 cents). It has been written by Mr. R. van Tress, and maintains the well-known practical outlook of this Museum's publications. Such well-tried subjects as the *Aspidistra* (here called, most appropriately, the 'cast iron plant'), the small conifer *Araucaria excelsa*, various geraniums, and the india-rubber plant (*Ficus elastica*) are known to all. The leaflet also shows that hybrid species of *Hippeastrum*, *Hydrangea*, *Poinsettia*, *Begonia*, *Azalea*, *Primula sinensis*, heliotrope, the African violet (*Saintpaulia ionantha*), the shrimp plant (*Beloperone guttata*) and many others, including the common English ivy, are suitable for domestic conditions. They give greater and more varied beauty than the better-known species. Many illustrations enrich the leaflet, and there would seem to be no reason why the plants mentioned therein should not succeed in Great Britain as well as in the United States.

Supraconductivity

The issue of the *Journal of the Washington Academy of Sciences* of June 15 contains the address of the retiring president of the Academy, Dr. F. B. Silsbee, of the Bureau of Standards, delivered in January. It extends to twenty pages, and deals with the additions which have been made during the last two or three years to our knowledge of the electrical properties of metals at very low temperatures. References are given to previous summaries up to 1935 and to nearly thirty memoirs on the subject which have been published since, most of them in 1936. The original description of a supraconductor as one in which the resistivity is zero is beginning to be replaced by the newer one that the magnetic induction is zero and that any current which flows in it is confined to an excessively thin layer at its surface. The abruptness of the change of conductivity as the temperature is lowered has been investigated, and in the case of tantalum has been expressed by means of the error function. The paradox of how a magnetic field which cannot penetrate a supraconductor can still affect its conductivity is still unsolved, and the reasons for the decrease of heat conductivity and increase of specific heat in the supraconducting state have still to be determined.

Philadelphia Academy of Natural Sciences

This year the Academy celebrates its one hundred and twenty-fifth anniversary, and the opportunity has been taken of relating to friends and members in a special report the work accomplished during the past year. The title chosen for the report is "Discovery" (which unfortunately duplicates the name of a well-known British scientific periodical). The year was marked by the announcement of an ambitious programme which included the strengthening of the scientific work of the Academy, the inauguration of an Education Department which would correlate the work of the Academy with the public and private school system in Philadelphia, the erection of modern educational exhibits, and the re-establishment of the Department of Geology and Palæontology. For the support of the educational programme over a five-year demonstration period a sum of 374,915 dollars was required, and the response to the end of 1936 reached the fine total of 241,135 dollars. Already important steps have been taken towards the accomplishment of the programme, and we note with satisfaction that the first step was to restore the reductions which had been made during the period of stress in the salaries of the staff. We join with the Academy in lamenting the death on January 22 of its president, Mr. Effingham B. Morris, who since his election to the presidency in 1928 has been the leader and stimulus in all phases of the Academy's work for science and for the community.

Peace Movements

The "Peace Year Book, 1937" (London: National Peace Council. 2*s*.) contains a good deal of useful information on international affairs and should prove a reliable book of reference on the peace movement throughout the world. It includes directories of peace organizations in Great Britain, of national organizations, Anglo-foreign societies and local peace organizations as well as peace and kindred organizations abroad. The appendixes include the text of the Covenant of the League of Nations, a bibliography of books and pamphlets, notes on the reform of the League, the Mandates System, an analysis of the armaments situation and an extensive summary by Dr. Hilda Clarke of the report of the Royal Commission on the Private Manufacture of and Trading in Arms. The first part of the book contains articles on international affairs, the situation in Spain receiving special attention, and the work of the League of Nations in 1936 is reviewed by Maurice Fanshawe. Of special interest to scientific workers is an able article in the second part of the book by J. D. Bernal on "Science and Peace", in which some account is given of the work of the Science Commission of the World Peace Congress. The general resolution on the attitude of scientific workers to war is given in full, together with the report of the Science Sub-Commission, and Mr. Bernal indicates some of the responsibilities of men of science in this matter.

Training in Domestic Science

IN the *Electrical Age* of July 1, a quarterly journal published by the Electrical Association for Women, an interesting description is given by Anne R. Macarthur of the Glasgow and West of Scotland College of Domestic Science, one of the most important women's training colleges in Great Britain. There are now three hundred students taking the three years (sometimes four years) 'teaching diploma' courses. In addition to the usual household subjects are cooking for sailors and yachtsmen, hygiene, etc. The college was built in 1911, the rooms being light, airy and spacious, but it was no sooner finished than it was taken over as a War hospital. During the past session, 1,697 students have attended the college for diploma courses as teachers of domestic science and as dieticians. They have the advantage of working with every type of equipment which they are likely to meet on completion of their course. Electricity figures prominently in the 24 kitchens, 5 laundries, 14 sewing rooms and in the residences and model flats of the College. The College residences are lofty houses overlooking Kelvingrove Park and all have bedrooms for one, two or more occupants, pleasantly furnished sitting-rooms and modern bathrooms. A common room with a parquet floor and softly coloured furnishings extends the full width of the building. On the roof, a bijou isolation hospital, with a small electrically equipped kitchenette offers comfort and most hygienic conditions to invalids.

Natural History in the Schools

THE annual reports of two school societies, the Marlborough College Natural History Society and the Rugby School Natural History Society, suggest that the schools are taking their due place in the training of the naturalists of the future. Both Societies have had a busy year. Marlborough has dropped from the report the local hand-lists, which must have given to young collectors many a useful pointer towards identification of species, and it has discovered that the members prefer an informal ramble to the massed expedition of a formal field day, which is all to the good from the point of view of training observation. Rugby includes long lists of the seaweeds and marine fauna of Port Erin, which do not seem to be particularly appropriate, although the introduction on the zoning of marine forms illustrates a useful type of observation. Both reports contain records of the local fauna made by members, and both Societies have a useful credit balance on the year's accounts, notwithstanding that Rugby spent more than £400, mostly in erecting a new vivarium and in altering and redecorating the rooms of various sections.

Agricultural Research in Great Britain

THE annual reports on the work carried out at the various agricultural research institutes in the United Kingdom during 1934–35 have now been published (H.M. Stationery Office. 5*s*. net). The volume also includes reports of certain other agricultural investigations carried out under the auspices of the Agricultural Research Council, and an account of the research activities of the agricultural advisory officers. In view of the scope of the work described, it has of necessity been published in summarized form, but those desirous of further information will find references to the original papers in the appropriate section, and the names and addresses of the directors of the institutes to whom inquiries may be sent.

Grants for Metallurgical Research

THE Iron and Steel Institute offers annually a limited number of grants from the research fund founded by the late Mr. Andrew Carnegie in aid of metallurgical research work. The object of the scheme is to enable students who have passed through a college curriculum, or have been trained in industrial establishments, to conduct researches on problems of practical and scientific importance relating to the metallurgy of iron and steel and allied subjects. The value of the grant will depend on the nature of the proposed research work, but the maximum amount granted in any one year will, as a rule, not exceed £100. Applications for grants must be made before September 30. Further information can be obtained from the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

Third Prehistoric Congress of the Far East

THE third Prehistoric Congress of the Far East will take place at Singapore on January 24–29, 1938. Membership of the Congress is confined to delegates nominated by their respective Governments or by scientific societies and institutions. Other anthropologists and prehistorians, however, will be allowed to attend the sessions of the Congress as visitors. They will enjoy all the privileges of members of the Congress, with the exception of the right to vote. The official languages which will be recognized are English, French and German. There is no subscription. Applications for invitation should be addressed to the Director, Raffles Museum, Singapore, Straits Settlements.

Metal-Ammonia Ions

In connexion with the letters from F. J. Garrick and from Dr. J. S. Anderson, N. L. Spoor and Prof. H. V. A. Briscoe published in NATURE of March 20, 1937 (p. 507), Prof. A. A. Grünberg, Kovensky pereulok 22, log. 12, Leningrad, has been good enough to give references to several papers by himself and his collaborators which are for the most part inaccessible to English readers. In these, during the last seven years, it has been shown experimentally that the ammines of platinum and rhodium may undergo acid-dissociation by a mechanism similar to that inferred from the exchange experiments on cobalt ammines. Prof. Briscoe and his collaborators state that they are glad to learn that their entirely independent experiments afford, both qualitatively and quantitatively, so satisfactory a confirmation of the findings and predictions Prof. Grünberg has already published. Of the more recent references he gives, one (A. A. Grünberg and D. T. Rjabtschikoff, *Acta Physico-Chimica*, 3, No. 5, 555; 1935), which is in German, and may be seen in a few British libraries, should certainly be consulted by chemists interested in this subject.

Medical Research in India

THE first annual report, for 1935–36, of the Indian Institute for Medical Research has been issued by the Governing Body. The Institute in Calcutta commenced work on January 1, 1935, with a 'diagnostic' section, for helping medical practitioners, and four research departments, and a brief survey of research work carried out is given. This includes the preparation of a potent anti-cholera serum, trials of which are now being carried out, a vaccine for the treatment of oriental sore (leishmaniasis), nutritional researches, with the discovery that some common Indian fruits contain a high content of vitamin C, and the mechanism of antigen-antibody combination.

Announcements

THE second International Congress of Cosmobiology will be held at La Malou on September 19–21. Further information can be obtained from Dr. M. Faure, La Malou, Hérault, France.

THE second International Scientific Congress of Alimentation will be held in Paris in the second fortnight of October and will consist of the following six sections; physiology of feeding, rules for normal feeding, feeding in the colonies, the teaching and social importance of food hygiene, and the protection and supervision of articles of food. Further information can be obtained from M. Alquier, 16 rue de l'Estrapade, Paris 5e.

THE one hundred and fiftieth anniversary of the birth of the celebrated Czech physiologist and histologist Johannes Evangelista von Purkinje will be celebrated by a series of ceremonies and addresses at Prague, Brno and Bratislava on September 24–28. Further information can be obtained from the secretary, Dr. Jarmila Psotnickovà, 32 Katerinka, Praha II.

THE Serbian Royal Academy of Sciences, which is composed of four academies—those of social science, natural science, philosophical science and fine arts—recently celebrated the fiftieth anniversary of its foundation in the presence of the Regent, Prince Paul of Yugoslavia, Dr. Radenko Stankovitch, formerly professor of the Faculty of Medicine at Belgrade, the Patriarch of the Orthodox Church, and a number of other well-known scientific workers and high officials of the Balkan countries.

THE library of the Radcliffe Observatory, Oxford, is about to be transferred to its new quarters in South Africa, and publications intended for it should now be addressed to "The Radcliffe Observatory, Pretoria, South Africa", instead of to Oxford.

A LECTURE COURSE on industrial law has been arranged by the Industrial Welfare Society at its headquarters, 14 Hobart Place, S.W.1, beginning on October 4 at 6.30 p.m., for ten weeks, and will be conducted by Mr. H. Samuel, barrister-at-law. Further information can be obtained from the secretary of the Society.

AN exhibition of Egyptian antiquities newly found at Armant by the Sir Robert Mond Expedition has recently been arranged at the Archæological Institute, St. John's Lodge, Regent's Park, London, N.W.1, by the Egypt Exploration Society. The exhibition will remain open until September 25. Admission and catalogue are free.

WE have received a communication from the Secretary of St. Joseph's House, Diocesan Home for Boys (a home for orphan and destitute boys), 126 Baker Avenue, Salisbury, Southern Rhodesia, stating that it is proposed to encourage the boys in the study of science, including microscopy. The Secretary would be grateful for gifts of small microscopes which any reader may be prepared to present to the Home.

THE Sir William White Post Graduate scholarship in naval architecture (1937) of the Institution of Naval Architects has been awarded to Mr. Allan M. Baxter, of the Royal Technical College, Glasgow.

THE following scholarships for 1937 have been awarded by the Institution of Electrical Engineers: Duddell Scholarship to R. S. Peacock, King's School, Ely; Swan Memorial Scholarship to Dr. B. C. Robinson, Armstrong College, Newcastle-on-Tyne; William Beedie Esson Scholarship to R. P. Kinsey of Evershed and Vignoles Ltd.; Silvanus Thompson Scholarship to J. R. Catlin, of Igranic Co. Ltd.; David Hughes Scholarship to L. Lieberman, Queen Mary College, London; Salomons Scholarship to S. G. Bittles, College of Technology, Belfast; War Thanksgiving Education and Research Fund (No. 1), Grant of £50 to J. E. Parton, University of Birmingham; Paul Scholarship to T. H. Fulford, Acton Technical College, London.

ERRATUM.—Dr. Gwyn Williams informs us that the MS. of his letter "Kinetics of Catalysed Polymerization of Styrene" (NATURE, Aug. 28, p. 363) contained an error. The polymers produced have molecular weights of the order 3,000, not 5,000 as printed (p. 364, col. 1, line 10).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 428.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Light thought to have been seen in the Neighbourhood of Alternate Current Magnets

THE late Prof. S. P. Thompson showed that visual effects (excitation of the optic nerve) were produced when the head was placed in an alternating magnetic field.[1] He said, further:

"Nearly four years ago Prof. Birkeland of Christiania told me that his workmen at the nitrate factory at Notodden declared that they could see lights over the choking coils used to limit the currents supplied to the electric furnaces. This may have been in reality a subjective phenomenon similar to that now recorded."

No doubt the view expressed by Prof. Thompson is the most probable. It seemed worth while, however, as a 'fool experiment', to see whether objective lights could be detected by prolonged photographic exposure.

Dr. W. H. Hatfield, to whom I casually mentioned the idea, was so kind as to interest himself in it, and he had a suitable alternate current magnet constructed at the Atlas and Norfolk Works, Sheffield. The iron was, of course, laminated, the gap between the poles being about 0·7 mm. wide and about 8 mm. deep. The mean flux density through the cycle was 4800 lines per sq. cm.

The top of the magnet was flat, so that a photographic plate could be brought right up to the gap, the lines of force being parallel to it. An Ilford hypersensitive panchromatic plate was used, with a thin sheet of 'Cellophane' between it and the magnet.

If the effect existed, there should have been a dark line on the plate, corresponding to the gap. Exposures up to thirty days were given, but no positive result was obtained. Some test experiments indicated that a luminosity fairly distributed through the visual spectrum and just bright enough to be seen by a well rested eye should have impressed the plate easily in twelve hours. The actual exposure was some sixty times greater. It appears most improbable, therefore, that any objective lights can exist. Perhaps most readers of NATURE would have been content to assume that in the first instance.

RAYLEIGH.

Terling Place, Chelmsford.
August 17.

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[1] *Proc. Roy. Soc.*, B., 82, 396 (1910).

Cosmic Rays and Magnetic Storms

S. E. FORBUSH[1] has noted a systematic decrease of cosmic ray ionization at Cheltenham, U.S.A., and Huancayo, Peru, simultaneous with a decrease of the earth's horizontal magnetic force (H.F.), during magnetic storms of April 1937. V. F. Hess and A. Demmelmair[2] have confirmed the existence and world-wide character of the cosmic ray decrease by observations on the Hafelekar near Innsbruck. They agree with Forbush in concluding that the study of these cosmic ray changes during magnetic storms will give valuable information on the spectrum of the cosmic radiation.

It promises also to settle an important unsolved question which bears closely on the mode of origin of magnetic storms themselves. The most intense disturbance of the earth's surface field during a magnetic storm usually occurs in polar regions; but this is not the part of the disturbance with which the greatest change in the energy of the magnetic field round the earth is associated. The energy change depends mainly on the general decrease of H.F. that occurs in all latitudes during and after the main phase of a magnetic storm[3]. The polar magnetic disturbance appears to be due to electric currents in the earth's atmosphere, but it is not known where the general decrease of H.F. is produced, except that the main cause is above the earth[4]. It may be in the highest layers of the ionosphere or right outside the atmosphere.

Ferraro and I have tentatively suggested[5] that it may be due to a ring current encircling the earth at a radial distance of a few earth-radii, a, and composed of positive and negative charges in oppositely directed orbital motions. Størmer[6] had earlier suggested a ring current of much larger radius, composed of charges of one sign only. I have criticized this hypothesis on various grounds[3,4], one being that it would imply an appreciable modification of the earth's field, during a storm, throughout an immense volume of surrounding space, in a manner likely to alter considerably the normal paths of cosmic rays. The present observations give a quantitative relation between the change in cosmic ray intensities and the magnitude δH of the decrease in H.F. at the equator during a storm; they should, with the aid of such calculations of cosmic ray paths as have been made by Størmer and by Lemaître and Vallarta, lead to an estimate of the distance of the currents which reduce the H.F.

Below these currents the H.F. is reduced, above them it is increased, and there the main component of the earth's field corresponds to a doublet of magnetic moment $M + \delta M$ exceeding the earth's normal moment M. It is presumably this increase δM, in this outer space, which accounts for the decrease of cosmic ray intensities.

Theoretical discussion of the cosmic ray change might conveniently be based on the following simple model of the earth's field during a magnetic storm. It is not intended to represent all the important actual features of the field, even if the currents concerned are located in the high ionosphere, and still less if they are ring-currents outside; but it should give the order of magnitude of the radius a' at which the currents are located.

Take one third of the equatorial decrease of H.F. to be due to induced internal currents (having an equivalent magnetic moment $-\frac{1}{3}a^3\delta H$), and two thirds to be due to external currents. Take these to be distributed over a concentric spherical shell of radius a', the current intensity being proportional to the cosine of the latitude; the field within the shell will be uniform, $-\frac{2}{3}\delta H$, and outside it will be that of the doublet of moment $+\frac{2}{3}a'^3\delta H$. Thus, for $r > a'$, the equivalent doublet of the total field will be $M + \delta M$, where $\delta M = \frac{1}{3}(2a'^3 - a^3)\delta H$. In this region the existing theory is applicable, with merely this change in M. For $a < r < a'$, the field will be that of a doublet $M - \frac{1}{3}a^3\delta H$ and a uniform field $-\frac{2}{3}\delta H$; in this region special calculations are needed. The important point is to determine whether a'/a is but little greater than unity, which would indicate that the currents are in the high ionosphere, or of magnitude 2, 3 or more, which would favour the ring-current hypothesis of the main phase of a magnetic storm.

S. CHAPMAN.

Imperial College of Science,
South Kensington,
London, S.W.7.
Aug. 23.

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[1] *Phys. Rev.*, **51**, 1108 (1937).

[2] NATURE, **140**, 316 (1937).

[3] *Terr. Mag.*, **37**, 269 (1932).

[4] *Terr. Mag.*, **40**, 349 (1935).

[5] *Terr. Mag.*, **36**, 77–97, 171–186 (1931); **37**, 147–156, 421–429 (1932); **38**, 79–96 (1933).

[6] *Arch. Sci. Phys.*, **32**, 277 (1911).

The Cluster Theory of Imperfect Gases

DEVIATIONS from ideality of real gases are generally attributed to the effects of the volume of the molecules and to the attractive forces between them. The volume effect has been described fairly simply and accurately, but explanations put forward as to the way in which the attractive forces act are open to criticism. One of the older common explanations[1] is that the unbalanced attraction inwards on the molecules near the boundary wall results in their being slowed down before they hit the wall, thus giving a lower contribution to the pressure than they would in the absence of attractive forces. *As stated*, this appears to be a violation of the Principle of Equipartition of Energy. Another way of expressing *what is probably the same thing, is often preferred*[2]. In this, the deficiency in pressure is attributed to a lower concentration in the boundary layer arising out of a relatively higher potential energy in this layer, due to the attraction inwards. These explanations ignore the fact that adsorption measurements show that all known walls exert a strong attractive force on all gaseous molecules and that the concentration in the boundary layer is invariably higher than that in the body of the gas.

Extensive mathematical treatments of the properties of imperfect gases have been made by Keesom[3], Core[4], and others[5]. These are based on the well-known statistical law that the probability of finding molecules in an element of volume dv is proportional to $e^{-X/kT}.dv$, where X is the potential energy of the molecule. The treatment leads to the expected result that *molecules are more likely to be found in an element of volume within the range of molecular attraction than in a volume outside this range.* It also gives values for the 'second virial coefficient' of gases, a coefficient to which $\left(b - \frac{a}{RT}\right)$ of van der Waals' equation is in approximation.

Attempts at obtaining a kinetic picture of the above result lead to an interesting conclusion. Consider any molecule in a gas moving with a definite velocity. As it enters a region of lower potential energy such as occurs in the neighbourhood of another molecule its kinetic energy increases. During the whole of the period while it is in this region, except for the small fraction of time of actual collision, the molecule moves *faster* than before the collision. If this were the complete picture, molecules would spend *less* time in an element of volume within the range of molecular attraction. It might be argued that a consideration of all types of collisions would give a mean different from this. Calculations of a number of typical cases have, however, failed to reveal any exceptions. As an extreme example, overtaking and overtaken molecules spend a longer time than usual inside the range, but they would spend a still longer time inside the same volume if there were no attractive forces.

It is obvious from the above argument that molecules *normally avoid* elements of volume in the neighbourhood of attracting molecules, a fact that should give rise to a correction term of the same sign as the 'b' term of van der Waals' equation. The observed sign is, of course, the opposite. This can only be explained by assuming that a molecule, while in a range of low potential energy, sometimes loses part of its kinetic energy by collision with a third body, forming a stable 'cluster' with the other molecule. These clusters have a comparatively long life and more than compensate for the effect described above, giving a net result of the right sign. For complex molecules third body collisions are unnecessary, as the energy may be temporarily transferred to another degree of freedom of the system.

This phenomenon of stabilization is a general one entering into all kinds of equilibria involving fields of force. In the simple case of any molecule moving downwards in an isothermal box in a gravitational field, its velocity will increase and, in the absence of collisions, it will normally spend *less* time in the region of low potential energy. The Boltzmann distribution arises from the fact that a few molecules lose so much energy on collision with the walls that they are unable to rise to the top against the field, and spend therefore a much longer time at the bottom.

The existence of clusters has been postulated by many writers to explain their observations on various properties of real gases. Van der Waals[5] himself believed them to exist near the critical point; he used the term *Scheinassoziation*. In the derivation of van der Waals' equation of state by Herzfeld and Smallwood[6], the formation of clusters is realized. Volmer[7] discusses the likelihood of molecular aggregates acting as condensation nuclei in pure supersaturated vapours. The possibilities in the Cluster Theory to explain the behaviour of gases have not, however, been generally realized and the theory is not to be found in elementary textbooks.

Tri- and tetra-molecular clusters are formed in a similar manner, particularly at higher pressures. At normal pressures, di-molecular clusters predominate, a fact which, with the Mass Law, leads at once to an equation of state of the type of van der Waals.

It is proposed to discuss elsewhere the ways in which the Cluster Theory permits simple treatments of other physical properties of gases, such as specific heat, viscosity, light scattering, the Joule-Thomson effect, and the pressure-broadening of spectral lines.

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London.
June 15.

[1] See, for example, O. Maass "Physical Chemistry" by Taylor, vol. 1, p. 98 (1924); W. C. McC. Lewis "Kinetic Theory", p. 72 (1923); and Washburn "Principles of Physical Chemistry", p. 38 (1921).

[2] Fowler, "Statistical Mechanics" p. 291 (1936).

[3] Keesom, W. H., *Phys. Z.*, **22**, 129 and 643 (1921); **23**, 225 (1922).

[4] Core, A. F., *Phil. Mag.*, **46**, 256 (1923).

[5] A brief treatment is given by Herzfeld and Smallwood, "Physical Chemistry" by H. S. Taylor, p. 226 (1931).

[6] Van der Waals, Nobelpreisrede (Leipzig, 1911).

[7] Volmer, *Z. Elektrochem.*, **35**, 555 (1929).

A Method of obtaining Polarized Neutron Beams

RECENT progress in cooling methods have made it possible to obtain temperatures where kT becomes comparable with the energy separation, due to space quantization of nuclear spins in high magnetic fields.[1] The nuclei will, under such conditions, occupy the lower levels of space quantization more abundantly than the higher ones, provided that temperature equilibrium between the lattice of the cooled substance and its nuclei is obtainable.[2] This effect is equivalent to a polarization of the nuclei, and might be useful for obtaining highly polarized neutron beams without great loss of intensity.

Should the nuclei in question have a resonance level for absorption of slow neutrons (thus absorption by an S-level) it would be expected that the capture cross-section would be very dependent on the relative orientation of the neutron spin and the spin of the capturing nucleus. In the special case of an unexcited nucleus having the spin 1/2 and the compound nucleus—formed by slow neutron capture—the spin 0, the cross-section should be zero for neutrons the spin of which is parallel to the nuclear spin, whilst it should be normal for neutrons of opposite spin orientation. A substance the nuclei of which are polarized will thus polarize a beam of slow neutrons by selective absorption of one component of spin orientation. The degree of polarization will only depend on the ratio of occupation of the two levels of space quantization.

In the rare case of a group of thermal neutrons principally due to one nuclear resonance level, this method will furnish polarized beams of thermal neutrons, as the method proposed by F. Bloch.[3] In most cases, however, only neutrons belonging to one particular resonance level—thus neutrons having energies of several volts—will be polarized. Precession experiments with such neutrons will permit of measurements of their velocity.

Added in proof: Halpern and Johnson[4] point out that some paramagnetic salts could give higher magnetic scattering cross-sections for slow neutrons than iron, the atomic factor being bigger. At ordinary temperatures scattering of slow neutrons by paramagnetic salts will not furnish polarized neutron beams. It might, however, be useful to employ for the polarization method proposed by F. Bloch[3] paramagnetic salts magnetized at very low temperatures instead of magnetized iron.

HANS V. HALBAN, JUN.

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August 14.

[1] Kürti, N. and Simon, F., *Proc. Roy. Soc.*, A, **149**, 152 (1935). de Haas, W. J. and Wiersma, E. C., Rapport 7me Congr. Int. Froid, 267 (1936).

[2] Heitler, W. and Teller, E., *Proc. Roy. Soc.*, A, **155**, 629 (1936); Gorter, C. J., *Physica*, **3**, 995 (1936).

[3] Bloch, F., *Phys. Rev.*, **50**, 259 (1936).

[4] Halpern, O., and Johnson, M. H., jun., *Phys. Rev.*, **52**, 52 (1937).

Circular Ultra-sonic Grating in Liquids

A. Žáček and V. Petržílka have recorded observations of radial and torsional vibrations of annular quartz plates cut perpendicular to the optical axis and have found that, with radial oscillations, standing ultra-sonic waves, which can be rendered visible by means of precipitated lycopodium, are formed in the hole in the middle of the crystal plate.

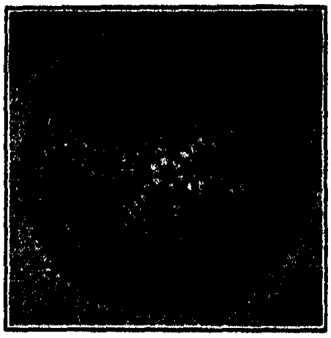

FIG. 1.

A closer investigation of the acoustic field showed that one was dealing with a complicated phenomenon, and that the ultra-sonic waves might be caused not only by radial vibrations but also by other types of vibrations, thus forming interesting figures of lycopodium. This fact was the reason for producing ultra-sonic waves in both gases and liquids, and observing them closely. These experiments have shown that the ultra-sonic waves formed in xylol, or better in a mixture of xylol and carbon tetrachloride, can be observed not only in the hole but also around the crystal plate. In the case of radial vibrations, only concentric circles are produced. If we make use of other types of vibrations, not only concentric circles, but also diametrical lines may appear (Fig. 1). This phenomenon is in all probability connected with the electrical axis of the quartz crystal. The circular grating formed in the liquids by the standing waves will be further utilized in diffraction experiments.

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July 28.

Vitamin E Deficiency in the Suckling Rat

IT has been reported previously[1,2] that partial deficiency of vitamin E in the doe rat leads to the production of abnormal young. This abnormality is associated with both anterior pituitary deficiency and thyroid deficiency. It is most marked when the litter is about eighteen days old and usually results in death three or four days later.

Since at birth the young, though small, appear otherwise normal, it seemed possible that the abnormality develops after birth and might be prevented if the young were fed by a normal doe. An E-deficient rat had a litter of three—two males and one female. Five days after birth, the two males were exchanged for four males from the normal breeding stock which were born on the same day. The stock mother then had her own females and the four normal males. All the young suckled by the E-deficient doe were abnormal at 16 days, and all were dead two days later. The thyroid glands were examined histologically and all showed the hypoplasia typical of this condition. All the young suckled by the normal rat grew well and showed no sign of abnormality. The experiment was repeated, with the same result, when the females from the two litters were exchanged on the fifth day, and again when the young were transferred on the day of birth.

This experiment shows that the young of vitamin E-deficient rats are born normal, but that thyroid and anterior pituitary deficiency develop as a result of the lack of some essential constituent of the mother's milk. This missing factor is almost undoubtedly vitamin E since lack of this vitamin results in similar changes in these glands in the adult rat, although the accompanying symptoms of stunted growth, uncalcified skull, clenched feet and weakness are not observed because the animal has already attained maturity.

M. M. O. BARRIE.

Physiological Laboratories,
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Graham Street, London, N.1.
Aug. 10.

[1] Barrie, M. M. O., NATURE, 139, 286 (1937).
[2] Barrie, M. M. O., *Lancet*, ii, 251 (1937).

Vitamin P

WE have reported previously that certain flavanones (vitamin P) greatly influenced symptoms of experimental scurvy. This latter condition was interpreted as a mixed C and P avitaminosis. At our request, our experiments have been repeated by several laboratories. The results were partly corroborative and partly negative. The reason of this discrepancy is now cleared up. Vitamin P requires for its activity the presence of traces of ascorbic acid. A scurvy diet frequently contains such traces which in themselves have no influence on the development of scurvy, but enable vitamin P to act. In the entire absence of ascorbic acid, vitamin P is inactive. Quantitative data will be published elsewhere. Previous conclusions are upheld. The object of this note is to prevent superfluous discussion.

A. BENTSÁTH.
A. SZENT-GYÖRGYI.

Szeged.
August 12.

Choline Esterase Activity of Superior Cervical Ganglia

BY a direct chemical micro method the maximum choline esterase activity of the superior cervical ganglion of the cat has been measured and found to be, on the average, equivalent to the splitting of 0·10 γ of acetylcholine chloride per sec. per mgm. of fresh tissue. The full experimental details will be given in another publication.

This figure may be applied to the data of Brown and Feldberg[1], who found that the greatest output of acetylcholine from the ganglion perfused with eserinized Locke's solution occurs in the first 5 minutes of preganglionic stimulation at 17 per sec. In this time 0·1 γ was liberated from a ganglion weighing 12·9 mgm. Hence the time required for the splitting of the acetylcholine liberated by one nerve impulse would be

$$\frac{0{\cdot}1\,\gamma}{12{\cdot}9\text{ mgm.}\times(0{\cdot}10\times10^{-3}\,\gamma/\text{mgm. }\sigma)\times(300\times17)\text{ stimulations}}$$

$$=0{\cdot}015\ \frac{\sigma}{\text{stimulation}};$$

provided that the enzyme and substrate are localized sufficiently so as to obtain a complete combination of the two, that is, theoretical maximum velocity of hydrolysis. Actually, the velocity falls when the concentration becomes less than a certain value; hence 0·015 σ represents a limiting least time which might be merely approached in actuality. Compared to the refractory period of the ganglion, which Brown[2] has found to be of the order of 2 σ, it is apparent that the enzyme need operate only with an average rate of about 0·75 per cent of its theoretical maximum velocity in order to destroy the acetylcholine liberated by a nerve impulse within the refractory period. After the first 5 minutes, the quantity of acetylcholine liberated per impulse falls until finally only about a fifth of the initial amount is set free[1]; under these conditions the enzyme could hydrolyse the acetylcholine within the refractory period at about 0·15 per cent of its maximum velocity.

From the foregoing it would appear that the enzyme present is sufficient to destroy the acetylcholine liberated by a nerve impulse within the refractory period. However, it must be borne in mind that for the conditions of minimum velocity of hydrolysis, as in the case of an even distribution of enzyme and substrate throughout the tissue, the reaction velocity would be very far indeed from the maximum one, because of the low substrate concentration and affinity for the enzyme. In this case the time (t_s) for splitting 99 per cent of the substrate is given by:

$$t_s=\frac{1}{V_{\text{max.}}}\int_{s_1}^{s_2}\frac{K_s+S}{S}\,dS,$$

where $V_{\text{max.}}$ represents maximum velocity of hydrolysis, K_s the Michaelis constant for the affinity between enzyme and substrate, S the substrate concentration at any moment, S_2 the original substrate concentration, and S_1 1 per cent of S_2. It follows that:

$$t_s=\frac{1}{V_{\text{max.}}}\left(K_s\ln\frac{S_2}{S_1}+S_2-S_1\right)=\frac{4{\cdot}6K_s+0{\cdot}99S_2}{V_{\text{max.}}}.$$

Since the value of K_s, which I am now investigating, is unknown for the enzyme from the source in question, it is sufficient for a rough calculation to assume it to be of the same order of magnitude as the K_s already found in the case of human serum[3], namely, 0·001, from which t_s becomes about 8 sec.

In order that this time be reduced to 2 σ, it would be necessary for the enzyme and substrate to be concentrated within a small portion of the total ganglionic volume, such as at the nerve endings. Already evidence for a localization of this type has accumulated[4,5].

The calculation given above is merely an approximation, and serves only to show the enormous gap between the time for splitting under minimum and maximum conditions, and the necessity for localization of enzyme and substrate within the ganglion cell if the theory of chemical mediation is to hold.

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Copenhagen.
Aug. 7.

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[1] Brown, G. L., and Feldberg, W., *J. Physiol.*, **88**, 265 (1936).

[2] Brown, G. L., *J. Physiol.*, **81**, 228 (1934).

[3] Glick, D., *Biochem. J.*, **31**, 521 (1937). *Compt. rend. Lab. Carlsberg*, 21, No. 15 (1937).

[4] von Brücke, F. Th.. *J. Physiol.*, **89**, 429 (1937).

[5] Dale, H. H., "The Harvey Lectures" (Williams and Wilkins Co., Baltimore, 1936–37).

Choline Esterase in the Central Nervous System

THE theory of transmission of nervous impulses to the voluntary muscles postulates the presence of a high concentration of choline esterase in nerve endings or their neighbourhood[1]. We have previously demonstrated the accumulation of choline esterase at the end plates of muscle[2]. We have now compared the rate of hydrolysis of acetylcholine in the grey and white matter of the spinal cord of the dog and found the concentration 10–20 times higher in the grey matter. 100 mgm. grey matter hydrolyse 7–9 mgm. acetylcholine in one hour, while 100 mgm. white matter split only 0·4–0·9 mgm.

In the central nervous system, as in muscle, choline esterase is found in high concentration in the tissue that contains nerve endings. This suggests that in the grey matter the enzyme may have a similar functional significance as at the end plates of muscle, that is, the rapid removal of acetylcholine, and that this substance may act as transmitter of nervous impulses in the central nervous system.

In the nervous system of crustaceans (lobster) there is also a higher concentration of choline esterase in the ganglion cells than in the nerve fibre.

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July 28.

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[1] Brown, G. L., Dale, H. H., and Feldberg, W., *J. Physiol.*, **87**, 394 (1936).

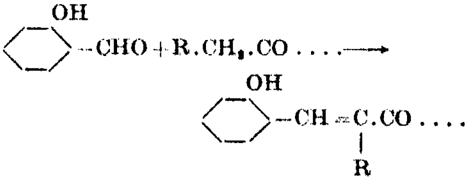
[2] Marnay, A., and Nachmansohn, D., *C.R. Soc. Biol.*, **125**, 942 (1937).

Specificity of the Salicylic Aldehyde Reaction of Csonka-Straub

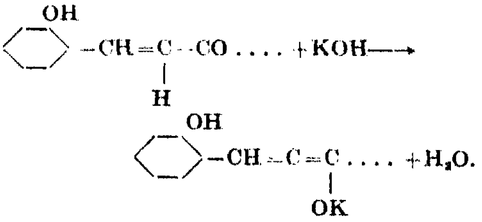
SOME time ago Straub (in Szent-Györgyi's laboratory) described a colorimetric method for the determination of pyruvic acid, similar to the method previously proposed by Csonka for the determination of acetone. In the presence of salycyclic aldehyde and concentrated potassium hydroxide, both substances develop a yellow colour, suitable for colorimetry. Having met with the necessity of determining pyruvic acid in the presence of several other keto-acids, I have made a study of the specificity range of this reaction and obtained the following results.

A positive salicylic aldehyde reaction is obtained with all compounds containing a CH_3CO group linked directly to a hydrogen or carbon atom; for example, acetaldehyde, acetone, ethyl acetoacetate, methylhexylketone, diacetyl, acetophenone, pyruvic acid, levulinic acid. The reaction is negative: (1) with carbonyl compounds that do not contain the above-mentioned group—formaldehyde, propionic aldehyde and higher homologues, ketobutyric acid and all higher ketoacids, fructose, dihydroxyacetone, acetonedicarboxylic acid; (2) with compounds containing a CH_3CO group linked to oxygen or nitrogen, that is O- and N-acetyl compounds, the CO group of which is not a genuine carbonyl group; for example, acetic acid, acetylglycine, acetylcholine, acetylsalicylic acid, triacetin.

The mechanism responsible for this very definite range of reaction specificity is obviously the following. In the first stage of the reaction salicylic aldehyde is condensed with the carbonyl compound to an oxybenzylidene derivative (Perkins' reaction):



If a menthyl group be attached to the carbonyl group of the original compound, that is, in the case R = H, enolization will ensue in a strongly alkaline medium, leading to the formation of an enolate, the intense yellow colour of which is due to the system of cumulated double bonds:



With R other than a hydrogen atom enolization and the formation of the cumulated double bond system is ruled out and no colour will appear, even though benzylidene condensation had taken place. With O- and N-acetyl compounds neither the condensation nor the enolization is obtained under the conditions of the colour test.

The salicylic aldehyde reaction is a sensitive test for the qualitative (and in many instances for the quantitative) determination of any methyl-carbonyl-derivative in the absence of other substances belonging to the same group. The reaction is very important as a valuable means for distinguishing these compounds from the homologous or substituted carbonyl derivatives. The specificity range outlined above should be especially kept in mind when making use of the reaction for quantitative studies on the metabolism of pyruvic acid, which may give rise to substances such as acetaldehyde, acetoin, acetoacetic and acetopyruvic acids and acetone, all falling within the specificity range of the Csonka-Straub reaction.

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A Cage Colony of *Anopheles gambiæ* Giles

MATHIS[1] has reported the successful rearing of *A. gambiæ* under laboratory conditions. He fed the adults on a guinea pig and found that mating occurred in quite small cages. For some years now I have made attempts to establish a laboratory colony of this species without any success. Great difficulty has always been experienced in getting caged adults to feed. The following animals have been tried: shaved guinea pigs, rabbits, goats and human beings. When feeding did take place, no fertilized eggs were recovered. Recently a further attempt has been made, and this has proved successful.

Adult *gambiæ* reared from eggs, obtained from gravid females captured in the field, were placed in an indoor cage lined with asbestos measuring 6 ft. × 5 ft. × 5 ft. The temperature in the cage was kept constant at 25° C. by means of a radiator connected to a thermostat. Large bird-baths and ferns were placed inside, yet the humidity of the air in the cage, as measured by a sling hygrometer, never rose above 40 per cent.

For a month the insects were given the opportunity of feeding on a human being every evening, and they very seldom took advantage of this. At the end of this period, however, nearly full-grown larvæ were seen in one of the bird baths and very robust adults resulted.

After this date a small pig was introduced and the mosquitos fed very readily. Eight days after introduction of the pig, first-stage larvæ were seen in the breeding dishes; these represented the second generation in captivity. Since that date hundreds of larvæ have appeared and third generation adults are now ready to deposit eggs. The colony is regarded as being firmly established.

BOTHA DE MEILLON.

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(South African Institute for Medical Research),
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August 6.

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[1] Mathis, C., *C. R. Soc. Biol.*, **121**, 21–22 (1936).

The Position of Genetics

THE attacks of Lysenko on Vavilov and other Russian geneticists reported in NATURE of August 21 are not wholly dissimilar to Dr. H. Dingle's attack on Prof. E. A. Milne in a recent issue of this journal. Vavilov was accused of being anti-Darwinian, Milne of going back to Aristotle, in neither case perhaps with full justification. If these attacks have led to a curtailment of Vavilov's work, the situation of genetics in the Soviet Union is indeed serious. If not, hard words break no bones, and the outlook for genetics in Moscow is at any rate no worse than in London, where I understand that the only department of genetics in the University is shortly to come to an end.

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Points from Foregoing Letters

LORD RAYLEIGH has made photographic tests to see whether, as had been supposed by certain observers, there were lights in the field of an alternate current magnet. The result was negative.

Prof. S. Chapman indicates that the decrease of cosmic ray intensity noted by Forbush in America (United States and Peru) and by Hess and Demmelmair in Austria, during the magnetic storms of April 1937, should throw light on the mechanism of magnetic storms; in particular, it should show whether the world-wide decrease of horizontal magnetic intensity during a magnetic storm is due to currents in the high ionosphere or to a ring-current right outside the earth's atmosphere.

The 'cluster' theory, which postulates that the molecules of imperfect gases occur in groups (mainly pairs under ordinary conditions), permits, according to C. F. Goodeve, a simple treatment of many properties of imperfect gases.

The possibility of obtaining polarized beams of neutrons by selective absorption on passing through a substance cooled to very low temperatures, the nuclei of which have a resonance level for absorption of slow neutrons, is pointed out by Dr. Hans v. Halban, jun. Paramagnetic salts magnetized at low temperatures might be employed for this purpose.

Standing ultra-sonic waves produced in xylol, or in a mixture of xylol and carbon tetrachloride, by an annular quartz plate can be observed within the ring and also outside the crystal plate. Miss J. Čeřovská submits a photograph obtained with radial vibrations, showing that a concentric circular grating has been formed in the liquid; this can be used in diffraction experiments.

Further experiments by Miss M. M. O. Barrie show that the young of vitamin E deficient rats are born normal but that they develop symptoms connected with thyroid and anterior pituitary insufficiency. However, if suckled by a normal rat, the young develop normally, showing that there is a lack of some essential constituent (probably vitamin E) in the mother's milk.

By a micro-chemical method D. Glick has calculated the rate at which choline esterase enzyme, acting on the super cervical ganglion of the cat, can split acetylcholine, a compound liberated during nerve activity. The time required is well within the refractory period of the nerve impulse, provided the known amount of enzyme and substrate are concentrated at the nerve endings. D. Nachmansohn has found an increased concentration of choline esterase at the nerve and plates of muscles and now reports that the grey matter of the spinal cord of the dog contains 10–20 times more choline esterase than the white matter. He suggests that the grey matter may act as transmitter of nervous impulses in the central nervous system.

The salicylic aldehyde reaction which gives a yellow colour with acetone and pyruvic acid (Csonka-Straub) is found by Prof. A. E. Braunstein to be a sensitive reaction for any methyl-carbonyl (CH_3CO) derivative, in the absence of other substances of the same group. The author directs attention to the fact that, in studying the metabolism of pyruvic acid, one should be on the look-out for substances such as acetaldehyde, acetoin, acetoacetic and acetopyruvic acids and acetone, which also give the Csonka-Straub reaction.

Research Items

Clan Reciprocity among the Bororo

IN an account of the social organization of the Bororo Indians of South America, M. Cl. Levi-Strauss refers to certain reciprocal obligations between clans, which he considers worthy of intensive study. He himself was able only to obtain a few discursive notes on the customs this reciprocity entails (*J. Soc. Américanistes de Paris*, N.S., **28**, 2). For example, when the young men are about to be initiated, the chief of the village entrusts their instruction to the phratry opposite to their own. On the death of a member of the tribe, it is customary for a collective hunt to be arranged. The organization of the hunt is entrusted by the nearest relative of the deceased to a member of the opposite phratry. The funeral emblems are handed to him, and he acts as organizer and leader. The preparation for the funerary dances is the duty of special clans; but the clan for whom the dance is prepared must take part as partners. This duality is well expressed in certain dances, in which the dancers stand in two lines and exchange places in the course of the dance. Each line or side belongs exclusively to one phratry. After the dance, the dancers are bathed by the members of the opposite phratry. An even closer tie binding the clans is formed by the interchange of food. At a stated time a member of one of the clans will carry a bowl of food from his own house to the men's house, where it is received with a ritual cry of welcome. Six or eight men of another clan are then fetched to the men's house, and partake of the food with their shell spoons. This exchange of food takes place reciprocally between all the clans, though with the exception of this ceremony and the giving of food to dancers after the dance, all meals are taken in the family dwelling. The privileges of the clans include the exclusive possession of names, songs, dances, and emblems and of certain techniques and materials. These rights are strictly respected.

The Human Sex Chromosomes

FROM a study of spermatogenesis in three individuals, Dr. P. C. Koller (*Proc. Roy. Soc. Edin.*, **57**, 194) has deduced some interesting conclusions. The length of the X-chromosome in man is found to be 4–5 μ and that of the Y 1·5 μ. These chromosomes frequently lie off the metaphase plate in mitosis, and in anaphase the Y frequently lags. In the leptozygotene stages of meiosis the X and Y are precociously condensed. They are divided into pairing and non-pairing regions. The non-pairing portion of the X is about two thirds of its length, while that of the Y, if present, is very small. The spindle attachment of the X is subterminal and is believed to lie in the pairing segment, so that crossing-over may occur on either side of it. The region between the centromere and the non-pairing (differential) segment is a quarter to a half that of the whole pairing region in which crossing-over will take place. Genes in this part of the X will show incomplete sex linkage, the linkage being lowest in loci farthest from the non-pairing segment. Both symmetrical and asymmetrical sex bivalents were found, and the X and Y sometimes fail to pair. In one individual chromatid bridges and fragments were observed. He was probably heterozygous for an inversion. Such inversions may yet prove to be of significance in the racial differentiation of man.

Barbels of Japanese Fish

THE structure and function of the barbels of two Japanese fish have been investigated by Mitus Sato (Sci. Rep., Tôhoku Imp. Univ., Feb. 1937, 3 papers). One, the goatfish, *Upeneoides bensasi*, has two long barbels on the chin, and the other, a sea catfish, *Plotosus anguillaris*, has four pairs of barbels, two pairs above and two below the mouth. The barbels in both fish have a central supporting cartilaginous rod and in the epidermis covering them lie a number of characteristic taste organs which are supplied by branches of the fifth and seventh cranial nerves. In the catfish such organs are also to be found in the lips. These organs are more important than either sight or smell in the selection of food. In the goatfish the removal of the barbels causes a loss of the power to distinguish food. This does not occur in the catfish, since some of the organs are left in and around the lips.

Chromosomes of Coffee Plants

A STUDY of the chromosomes of *Coffea* has been made by Dr. C. A. Krug (*J. Genetics*, **34**, No. 3), who confirms that $2n = 22$ in *Coffea arabica* and has found the same number in seven other species. Most of the cultivated varieties of *C. arabica*, however, are tetraploids; while the var. *bullata* of Cramer, which has broader and much thicker leaves, is an auto-octoploid ($2n = 88$) or in certain plants hexaploid. The octoploid condition also arises somatically on a branch of a tetraploid, and can revert somatically to the tetraploid. Hexaploids are much less frequent, so it is concluded that the octoploids probably arise through chromosome doubling after fertilization. Their fruits are abnormal, giving a very low percentage of germination. All the offspring were $4n$ except one $6n$ and one $8n$. The $4n$ plants may have arisen parthenogenetically. The pollen meiosis in the octoploids is irregular, only about 62 per cent of the tetrads having four microspores. From $4n \times 8n$ seven plants were obtained, all having $2n = 44$. These must have arisen from parthenogenesis or by the fertilization of $2n$ eggs by $2n$ pollen. The hexaploids also show high gametic sterility and low seed production. Four seedlings were produced, three of which had 66 chromosomes and one 44. In reciprocal crosses between *C. arabica* ($2n = 44$) and *C. canephora* ($2n = 22$) a triploid hybrid plant produced misshapen seeds with little or no perisperm but with normal embryo. *C. canephora* has several chromosomes longer than the rest, and these are recognizable in the hybrid.

Petrofabric Study of Moine Schists

AT the meeting of the Geological Society on May 5, F. C. Cole presented an important paper dealing, for the first time, with the application of petrofabric analysis to the problems of the metamorphic rocks of the Highlands. In all, 85 analyses of quartz and mica fabrics of Moine schists have been made. Specimens collected over a wide area have given in every instance a well-marked girdle-diagram, indicating that the schists are typical *B*-tectonites. In these, the direction normal to a girdle, known as the *b*-axis or tectonic axis, has the same significance as a visible fold-axis. The *b*-axes of the Moines pitch uniformly into the south-east quadrant, suggesting that the present regional metamorphic condition of the Moines is the result of movements along approximately south-west and north-east lines. The effect of the post-Cambrian overthrusting on the fabric of the schists is also examined. Relics of the earlier fabric are traceable in partially mylonized rocks, but the thrust movements have had little or no constructive effect, being in the main cataclastic, and the continuity of the structure is lost. The evidence indicates that the general metamorphism of the Moine schists was effected by movements, earlier than the overthrusting phase of the Caledonian orogeny, acting in a direction almost at right angles to the direction of overthrusting, but parallel to pre-Torridonian directions of movement in Lewisian areas.

Drilling of a Deep Pressure Test in India

EXPERIENCE has shown that problems pertaining to the drilling of a well under pressure to great depth are many and formidable. The main difficulties to be overcome are shallow zones of low-pressure sands, which cause loss of fluid and circulation, deeper high-pressure water and gas sands, 'heaving shale' formations and hard formations, which retard drilling and are conducive to crooked holes. Mr. G. F. Wilson, in a paper presented to the Burma Branch of the Institution of Petroleum Technologists on May 4, described measures which have been adopted to overcome these particular difficulties when drilling a deep well in India. The casing was set below the low-pressure zone; heavy mud was used as well as pressure drilling; by continuous maintenance of pressure and the use of treated muds, heaving shale formations were penetrated and the effect of hard formations counteracted so far as possible by provision of a hydraulic table. The history of this test well showed that pressure drilling is quite practicable for prolonged periods, providing the best obtainable equipment is used. Where, however, rock pressures are known and can be dealt with by mud, it is better not to employ pressure drilling, but to keep it as a standby, since the increased cost of fuel and equipment for drilling under pressure is in most cases greater than that of mud-loading materials.

Crystalline Structure of Pentaerythritol

THE elucidation of the structure of sugars by X-ray analysis has been hampered by lack of knowledge of various interatomic distances. F. J. Llewellyn, E. G. Cox and T. H. Goodwin (*J. Chem. Soc.*, 883; 1937) have made an analysis of the relatively simple compound pentaerythritol, $C(CH_2.OH)_4$, which shows that the model consists of a central carbon atom surrounded by four CH_2 groups at the corners of an almost exact tetrahedron; each hydroxyl group is attached to its CH_2 by a bond making nearly a tetrahedral angle with the $C—CH_2$ link, and is so directed that the four OH groups lie at the corners of a square. The bond lengths and angles were calculated from the measured atomic co-ordinates and cell dimensions, the distances being $C—C = 1{\cdot}50$ A. and $C—O = 1{\cdot}46$ A., the first being slightly less than that found in diamond and usually assumed for aliphatic compounds, and the second almost exactly equal to the calculated sum of the half-bond lengths of carbon and oxygen. The structure of the lattice as a whole is of a very pronounced layer type, the molecules being linked together by hydroxyl bonds in sheets in the (002) planes, and the separation of more than 3½ A. accounting for the perfect cleavage parallel to {001}. The evidence supports the view that the relatively short distance between hydroxyl groups represents a hydroxyl bond in which a hydrogen atom binds two oxygen atoms closely together while remaining attached essentially to one of them. The arrangement is very similar to that found in resorcinol. All other inter-molecular distances are much greater and correspond with relatively weak van der Waals' forces.

Determination of Lactoflavin in Milk

A RAPID method for the determination of lactoflavin (vitamin G) in milk by a fluorimetric method is described by C. H. Whitnah, B. L. Kunerth and M. M. Kramer (*J. Amer. Chem. Soc.*, **59**, 1153; 1937). To 10 ml. of milk, 15 ml. of 10 per cent trichloracetic acid is added, the mixture is allowed to stand for ½–1 hour and centrifuged for 5 minutes at 2,000 r.c.f. Ten ml. of the resulting serum is neutralized with methyl orange as indicator and diluted until the sample can be matched in the light of an Eveready Fluoray lamp with standard flavin solutions (Labco *PX* grade) containing 0·12–0·06 gamma of flavin per ml. The consistency of the method was confirmed, and comparisons with the biological assay by the Bourquin-Sherman method were satisfactory. Attempts are being made to apply the method to colostrum, which is higher in lactoflavin content than normal milk.

Classification of Stellar Spectra

THE spectral classification of stars of types *A* to *K* has recently been discussed by W. W. Morgan (*Astrophys. J.*, **85**, 380), who points out the desirability of a two-dimensional system of classification depending on effective temperature and luminosity. The system should be in empirical units based on the actual observed criteria in the spectra, so that no errors are introduced by assumptions involved in reducing these to values of the corresponding physical parameters. The Henry Draper notation provides a suitable method of classification in the temperature direction which is practically constant for all values of the surface gravity in the stars considered; but the criteria on which it is based should be as far as possible independent of a star's luminosity. Classification in the luminosity direction should similarly be based on lines which are unaffected by temperature over the range in which they are employed. The author suggests, as simple criteria which fulfil these conditions, some single line intensities, intensity ratios and differences. They enable the H.D. type to be determined with high accuracy, and (for types *A*7 to *K*9) give an additional numerical classification directly related to luminosity. The criteria for types *A*0 to *A*6 are not sufficiently accurate to give more than a 'group' classification (for luminosity) into super-giants, main sequence stars and white dwarfs.

The Bone-Bearing Beds of Bethlehem: Their Fauna and Industry

By Elinor W. Gardner and Dorothea M. A. Bate

IN a note in 1934 (NATURE, Aug. 11, 1934, p. 219) one of us (D. M. A. B.) directed attention to an interesting discovery of elephant remains in a deposit at Bethlehem. This was the result of a cursory examination on the spot undertaken for the Department of Antiquities.

Shortly afterwards, the late Sir Henry Wellcome became interested in the site, and a concession was obtained by Mr. J. L. Starkey from the Department of Antiquities, Palestine, for the Wellcome Archæological Research Expedition to the Near East. In the spring of 1935 the Geological Section of the above Expedition began its first season's work with E. W. Gardner as geologist and D. M. A. Bate as palæontologist. It was continued in 1936 under the same auspices, and resumed in 1937, thanks to the enthusiastic support of the trustees of the late Sir Henry Wellcome and of Sir Robert Mond.

GEOLOGY

The bones were first found by the owner of a garden digging for water on the highest point of Bethlehem, 790 m. above sea-level. On all sides the ground falls away, on the east towards the Dead Sea Rift, on the west towards the Mediterranean.

The position of the deposit isolated on the highest part of the Judæan arch at once, therefore, aroused interest, for the solution of the problem of its origin would certainly throw interesting light on the past physiography of the region and its relation with the Rift Valley and Transjordan.

In the original pit, elephant bones were seen *in situ* at 15 m. below the surface. On opening up the area they were found some 6 m. down in a coarse gravel with a stiff clay matrix, which makes their extraction a slow and difficult business. The gravel consists mainly of chert of all sizes, some blocks being half a metre or more big. Limestone is a minor constituent, but is locally abundant. A few iron nodules are also found. The materials are very little sorted, and are mostly derived from local Cretaceous rocks, with the exception of the iron nodules, which are more characteristic of the Eocene.

As the excavation was enlarged it seemed in the first season as though there were two gravels separated by a bed of pure clay, all dipping east, but later work showed that in depth the two gravels coalesce. They are both bone-bearing, in contrast to the pure clay, which has never yet yielded any remains.

Those in the western gravel are badly preserved, perhaps because they occur nearer the surface and are less protected by deposit of lime or nari towards the top. An interesting specimen found there was a jaw of an elephant, and perhaps part of the skeleton. The mass of bone, 3 m. long, dipped, with the beds, steeply to the north-east; while some of the deposits in the north-east corner—the original area—dip as steeply (±40°) to the south.

In 1935 no junction of the gravels and clays with country rock was found, and therefore in 1936 the area was enlarged in the hopes of finding one.

On the east and south a white chalky rock, nari with lumps of limestone, had already been sporadically uncovered, and on cutting back the south side it increased rapidly both vertically and laterally. In places it arches over the gravel, sometimes with a very clean junction. It is veined with red clay, which in places develops into pipes narrowing upward, and mostly dipping eastward. In depth blocks of limestone, some with fossils, become more and more abundant and of increasing size. The surface of these is weathered sub-aerially, and often shows characteristic carving and fretting.

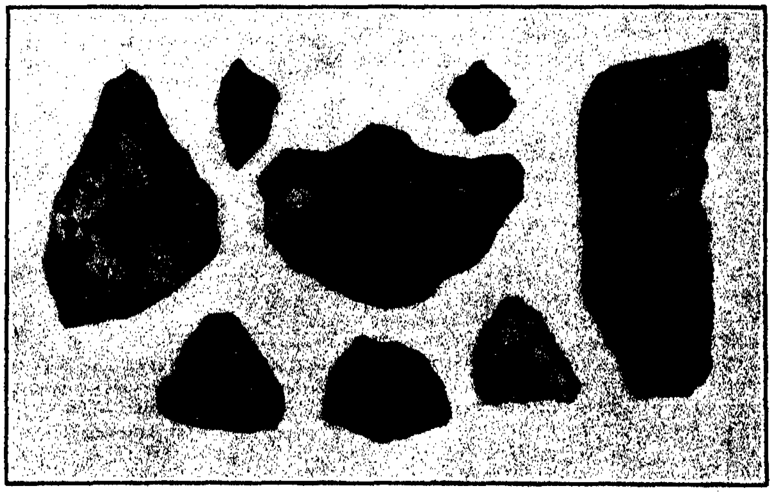

Fig. 1.

The gravel in the west lies on this deposit, which may be called a cemented scree or breccia, at a steep angle, and sometimes penetrates into it as pipes. The approach of the scree is heralded by increasing numbers of limestone boulders in the gravel and by the reddening of the clay. In the east and south-east, on the other hand, the junction is sharp and vertical, or nearly so, the gravel and clay fall away under the pick in big masses, leaving a clean face of white rock. In the same area vertical or steep clay faces are exposed in the same way, and these, if not on the junction, are always very near it.

On the south the steep scree face has been followed down for 11 m., at which depth it flattens out into a small platform before plunging down again. From the northern edge of this platform a hard triangular mass of breccia rises two metres above the floor. The space between it and the southern wall was filled with grey bone-bearing gravelly clay, which ended quite abruptly against the breccia block. A somewhat similar but smaller mass has been found in the north-west corner. The irregularity of the surface of the scree deposit, together with the nature of the junction with the bone-bearing beds, seems to indicate that it was formed before them and that they were laid down on and against it.

In the south-east corner yet another curious deposit was found. This consisted of a pipe—3 m. broad—in the nari and scree, filled with blocks of chert of all sizes, some more than a metre in all dimensions. In contrast to the chert in the gravel, which is more or less worn, these blocks of whatever size are sharply angular.

The pipe slopes in the north-east and ends some 6 m. down after narrowing slightly, and finally disappears in the narrow cracks of the cemented scree. On the south side of the pipe near the base the scree contained some remarkable polished cherts. They were found in pockets of red clay in the scree and were mixed with quite unworn and angular fragments. The polish is so high that it is more like a glaze. In some cases the cherts are intensively worn, in others and more frequently, they are less so and show numerous flake scars.

It is still too soon to discuss the origin of all these materials, but there can be little doubt that the gravel and clay bone-bearing series is a water-laid deposit, and that the bed against which it rests is a sub-aerial one.

The gravels are rapidly contracting in area as they go down and this, in conjunction with the inward dip, points to the filling of a roughly funnel-shaped hole, or alternatively to the collapse of the original floor on which they were laid. Whatever may be the ultimate decision, the impossibility of any such deposit forming in its present position indicates wide physiographic changes, which in their turn point to a great age. More exact dating must be left to the palæontologist.

ARCHÆOLOGY

It is possible, however, that some help in the dating problem may be obtained from implements. Throughout the work a close watch has been kept for human worked flints, but until this year nothing definite was found. Now, however, a number of possible tools have been obtained, in the bone-bearing gravel, and these, if accepted, will be invaluable not only in dating, but also in helping to trace the deposits elsewhere.

Miss Caton-Thompson, who saw them *in situ*, and has kindly consented to work them out, contributes the following note:

"The cherts in the deposit have a wide variation in size, ranging from huge blocks to small chips and pebbles. Both tabular and nodular varieties are present. The former is mainly represented by a pale greenish chalcedonic chert with a rough or corrugated cortex; the latter by a dark grey-to-black 'chalk flint'. A peculiar local variety, favoured on certain sites by Acheulean man for hand axes, is also included; it has the appearance of an angular pudding-stone, and is known as brecciated chert.

"The play of mechanical forces on the flints is strikingly evident. Striations, shattering, bruising, crushing, rolling and thermal action are all visible. Taken as a whole, however, rolling is very slight compared with normal gravel constituents, and a considerable proportion of the material is relatively fresh.

"The danger of claiming humanly-fashioned tools from such an assemblage and so vast a selection is obvious. Nevertheless, we think that a certain number of pieces are difficult to explain in other terms. They will provoke healthy controversy as acute as that which has beset the 'artefacts' from the Red Crag of Foxhall, or the sub-Crag detritus bed flints at Bramford. Many of the Bethlehem 'artefacts' resemble the latter, in so far as both, when of tabular flint, conform closely in shape and edge trimming to the classic type of Harrisonian eolith. This is the first time they have been found in a sealed deposit in Palestine or the Near East, though Mr. Starkey has long known them from the bed of Wadi Ghuzzah. Flakes, though rarer, are also present, and display 'striking platform' and/or bulb.

"Balancing the probabilities, we think the type of flaking and edge trimming exhibited on these admittedly selected specimens is less easy reasonably to explain as the accidental work of natural forces, than as the deliberate experimental work of man in remote pre-Chellean times." E.W.G.

PALÆONTOLOGY

The first discovery of fossil elephant remains in Palestine was announced in NATURE of August 11, 1934, p. 219. Subsequent finds have been made in the Wady Mughara caves and in the bed of the River Jordan not far from its exit from Lake Huleh, but both these are of later date than the deposit at Bethlehem which yielded the first remains. In fact, with the possible exception of a single specimen which I hope to describe shortly, the Bethlehem deposit has yielded a mammalian fauna of earlier geological age than any so far known from Palestine. As yet it has been possible to make only a preliminary examination of the animal remains obtained during the three seasons' work; this has revealed the presence of the following vertebrates:

Felis sp. (size of *Panthera leo*)
Hippopotamus sp.
Bos sp.
Antelope
Giraffoid
Hipparion sp.
Rhinoceros cf. *etruscus*
Stegodon sp.
Elephas sp.
Testudo sp. (of gigantic size)
Testudo sp. (of very small size)

Besides the above species there is known to be a small carnivore, but its remains are extremely fragile and have not yet been extracted from the matrix. With, perhaps, the exception of the large *Felis*, the *Bos* and the tiny tortoise, all these species are new to Palestine, and without doubt represent extinct forms.

Among the mammals the name *Bos* is used in a broad sense, since the species is known only from portions of horn cores. Likewise the antelope and the Giraffoid are only represented by a small number of skeletal remains. The discovery of *Hipparion* is of special interest, both chronologically and geographically. Species are known from many Tertiary deposits in Asia, including India, and are generally considered to be typical of the Pliocene. Last year (1936) Father Teilhard de Chardin and Prof. de Terra recorded *Hipparion* remains from the Basal Pleistocene of India, although they themselves did not wish to claim this dating as proved conclusively. The find at Bethlehem seems to suggest that further corroboration may be forthcoming from India. In

East Africa, on the other hand, *Hipparion* remains are well known from Pleistocene deposits, and have been recorded from Oldoway, Beds I–IV, from Kaiso and from Lake Rudolf.

The Bethlehem *Rhinoceros* has been compared with *R. etruscus*, since some of the upper cheek teeth appear to be similar; the height of the crowns is, if anything, slightly less in the Palestine specimens. In this connexion it is of interest to remember that the late Dr. W. D. Matthew compared the Indian *Dicerorhinus platyrhinus* with *R. etruscus*.

The discovery of the *Stegodon* remains is of outstanding moment. This is essentially an Asiatic genus, though Dr. A. T. Hopwood allows me to mention that its occurrence in African deposits is now known and will shortly be published. India during the Pliocene appears to have been the great centre for the adaptive radiation of the *Stegodon* group. Here the genus lingered on into the Middle Pleistocene; in Java it is known from an even later horizon. As might be expected, the *Elephas* from Bethlehem is represented by a primitive form with low-crowned cheek-teeth.

The gigantic tortoise is known from a considerable number of plates from the bony carapace and plastron. Most of these were collected early this year and have not yet been examined critically. It will be remembered that remains of a gigantic tortoise were discovered by Dr. Leakey in East Africa in 1935.

Many of the animal remains have been subjected to pressure, and this corroborates the geological evidence that movements must have taken place after their inclusion in the deposit. Frequently it has seemed evident that complete carcases have been embedded in the deposit, notably in the case of the elephant quoted above by Miss Gardner. Likewise it may be mentioned that so far the animal remains have given no indication of a difference of fauna from different parts of the excavation.

Unfortunately, owing to local conditions, specimens are generally very fragile, and always difficult to extract. It is hoped, however, that further work next spring may result in the acquisition of still larger collections, which will enable us to extend our knowledge of this new fauna.

In conclusion, it is suggested for the Bethlehem fauna that its origin is Asiatic, and that its age is not later than Early Pleistocene, using this term palæontologically as indicating the time of arrival of true *Bos*, *Elephas*, and *Equus*. The fauna also indicate a warm climate, with a more liberal supply of permanent water than is found in the country at the present day. Further, it is claimed for this fauna that it will provide a faunistic link for this period between Asia and East Africa, enabling a better understanding to be reached regarding the migrations and centres of dispersal of various mammalian groups.

D. M. A. B.

The Lake District as a National Park

THE question of the afforestation projects which are being carried out by the Forestry Commissioners has been the subject of considerable controversy and alarm among residents of the Lake District and those who have an admiration for this beautiful piece of England.

The Friends of the Lake District have recently published a pamphlet entitled "Make the Lake District a National Park" (Ambleside: Friends of the Lake District. Sec., 2 Midland Bank Chambers, 1937), which is, in effect, an appeal to all lovers of the Lake District based on a new method of treating and preserving this unique region without involving any of the upset to local agricultural methods which is one of the strong objections offered to the Forestry Commission's activities. The pamphlet opens with the sentence, "Regions of great natural beauty have a lasting value for the refreshment and inspiration of man." The object of the proposal to create the area a national park is to preserve for the future the outward aspect of the district as at present seen "with the grand and the beautiful in splendid harmony". The formation of a national park does not necessarily entail the nationalization of ownership. "The policy has no quarrel with the essentials of the present system of land holding, or with the enjoyment of private property as such. It can be achieved inside the traditional framework."

One of the great objections to the afforestation proposals of the Forestry Commission has been the disturbance involved to local methods of agriculture, and especially to the famous strain of Herdwick sheep. The fells of the Lake District are rough grazing, occupied by Herdwick sheep; and, since there is no conflict of interest between sheep and the pedestrian, the local agricultural system and free access, it is said, are good partners.

The valley bottoms are not arable, but grass land with a generous lay-out of footpaths on the 'inside land'; the meadows do not run far up into the daleheads, nor do the 'intakes' run far up on to the hillsides. The whole configuration and covering of the land is, given moderately free access, ideal for the formation of a national park. The tourist industry, second in importance only to the sheep, will greatly benefit and thus assist the local hardy inhabitants to enjoy a greater prosperity.

The Lake District extends over parts of the three counties of Lancashire, Westmorland and Cumberland. There are seven planning authorities in the Lake District and half a dozen highway authorities, while the Forestry Commission possesses full powers overriding most of these. In order to secure uniformity, the proposal made by the Friends of the Lake District is that a National Park Commission should be appointed by the Government with statutory powers for protective purposes to override other bodies; that the Commission should receive a grant from the taxpayers' money and that it would be responsible to Parliament only. In return for the outlay the public, by arrangement with the landowners and commoners, would acquire a right to utilize all paths, etc., which have for long been frequented by the courteous permission of such proprietors and commoners. Any other national parks created in the country would be placed under the general control of the National Park Commissioners.

Science News a Century Ago

The Insulating Power of Fluids

IN 1837, Faraday was making researches connected with the induction, and the conduction of electricity by various types of insulators. As is generally known, his observations were entered in his diary in numbered paragraphs, the entries for September 6, 1837, running from No. 3875 to No. 3891. The first few of these were as follows:

"3875. Tried insulating power of some fluids by dipping a glass rod in them and then touching a gold leaf electrometer with the wet part, the finger being also applied to the wet part about the third of an inch from the electrometer. Thus a film of the liquid of about half an inch long formed the communication.

"3876 *Oil of turpentine*—good and filtered; insulated well.

"3877 Oil of turpentine—old and with water at the bottom of the bottle; discharged the electrometer at once.

"3878 *Naphtha (french)*—insulated well.

"3879 *Oil gas liquid*— Do.

"3880 *Caoutchoucine*—discharged moderately.

"3881 Cocoa nut oil (the expressed solid part)—discharged at once.

"Hence Oil of turpentine, Naphtha and Oil gas liquid appear as if they would do for transinductive media."

Discovery of the *Victoria regia*

AT a meeting of the Botanical Society held on September 7, 1837, the secretary read a communication from Robert H. Schomburgh dated New Amsterdam, Berbice, May 11, 1837, on a new genus allied to the water-lily, which by permission of Her Majesty he had named *Victoria regia*. The discovery of the plant by Schomburgh, in the River Berbice, in British Guiana, was made in January. When on the river he saw something which raised his curiosity, "All calamities were forgotten; I felt as a botanist and felt myself rewarded. A gigantic leaf, from five to six feet in diameter, salver-shaped, with a broad rim of light green above, and a vivid crimson below, resting upon the water: quite in character with the wonderful leaf was the luxuriant flower consisting of many hundred petals. The smooth water was covered with them, I rowed from one to another, and observed always something to admire. . . . We met them afterwards frequently, and the higher we advanced the more gigantic they became".

British Association at Liverpool

ON Saturday, September 9, 1837, the General Committee of the British Association met in the library of the Liverpool Athenæum, the Marquis of Northampton being in the chair. In the course of the meeting it was announced that the Government, at the request of the council, had consented to repeal the duty on the importation of philosophical instruments, and also to extend the Ordnance Survey to Scotland. It was also stated that the council had directed its attention to the establishment of a law of universal copyright, and had entered into communication with M. Guizot, Minister of Public Instruction in France, and Mr. Sergeant Talfourd.

It was submitted and agreed to that admission to the General Committee, then open to the presidents and vice-presidents and office-bearers of chartered philosophical societies and contributors to the *Transactions*, should be extended to the officers of the Literary and Philosophical Society of Newcastle, the Natural History Society of Newcastle, the Wernerian Society of Edinburgh, the Royal Geological Society of Cornwall, the Geological Society of Dublin and the Statistical Societies of London and Manchester.

Babbage's "Bridgewater Treatise"

IN May 1837, Babbage published "The Ninth Bridgewater Treatise. A Fragment". It was adversely criticized in the *Mechanics' Magazine* of September 9, 1837, in which it was said that "almost every chapter is composed of mere scraps of composition, without any attempt to unite them into one whole; some chapters have no end; many more have no beginning and one at least might be fairly said to have neither beginning, middle nor end. . . . It is perhaps hardly necessary to do more", said the reviewer, "than state the plain fact that the main object of this Ninth Bridgewater Treatise is professedly to *raise our conception of the power and wisdom of the Creator, by comparing the mechanism of the Universe with that of Mr. Babbage's calculating engine*!"

Indulgent Examiners

THE *Lancet* of September 9, 1837, contains the following story from a correspondent, entitled "A New Method of Passing Apothecaries Hall": "Candidates who are rejected are most strongly recommended to commence *crying* immediately after the sentence of the Examiners is pronounced; this mode of appeal to the worthies of the Hall being likely to prove effectual for candidates in that predicament. A case in point occurred last week. A great boy on the wrong side of thirty left the room crying aloud. The sentimental event touched the feelings of the examiners and the scientific youth was called back after a few minutes into the presence of the Board, whence he returned to the 'funking' room with his diploma, where he commenced kicking up his heels and laughing most uproariously, and finally placing his dexter thumb to the point of his nose, in an expressive manner, quitted the Hall, perplexed much to know whether the operation of sneering or laughing was most suited to the occasion".

Preservation of Bodies for Dissection

THE issue of the *London Medical Gazette* for September 9, 1837, contains the following description of the method of preserving bodies for dissection invented by M. Gannal, to whom the Academy of Sciences in Paris awarded a prize of 8,000 francs: "The process simply consists in injecting an aqueous solution of an aluminous salt by one of the carotids; some pints are sufficient; after it the body may be preserved exposed to the air for a long time without putrefaction, and sometimes at last dries and is mummified. He uses acetate of alum prepared from the acetate of lead and sulphate of alum and potash; and five or six pints of a strength that will mark 18° on Beaumé's aerometer, are sufficient to preserve a body for five or six months. He has also used simple sulphate of alum for procuring the acetate. With one kilogramme of common sulphate of alum in lumps, 250 grains of acetate of lead and two pints of water, a mixture may be obtained sufficient to preserve a body four months; or common sulphate of alum alone will make one keep for two months".

University Events

Cambridge.—At King's College, K. P. Harrison and O. L. Zangwill have been awarded Harold Fry studentships, and D. S. Evans has been awarded a Martin Thackeray studentship. At Clare College, Denman Baynes research studentships have been awarded to J. V. Dunworth and T. E. Easterfield for natural sciences and mathematics respectively. At Emmanuel College the external research studentship offered to graduates of other universities intending to commence residence as research students in October next has been awarded to A. G. Ward (Queen's University, Ontario) for research in physics.

Durham.—The title of emeritus professor has been conferred on Prof. W. M. Thornton from the date of his retirement at the end of the session 1936–37. Prof. Thornton has been professor of electrical engineering since 1906.

Dr. Emrys Williams has been appointed lecturer in electrical engineering in succession to Dr. J. A. Wilcken, who has resigned, upon his appointment as assistant editor of *Science Abstracts* issued by the Institution of Electrical Engineers.

Societies and Academies

Paris

Academy of Sciences, June 28 (*C.R.*, **204**, 1909–1992).

Alfred Lacroix : A new basaltic type, comparable, from the chemico-mineralogical point of view, with the felspathic meteorites.

Mme. Hilda Geiringer : Chance variables arbitrarily connected. Case of convergence according to the law of Gauss.

Fumimoto Maeda : Nuclei of the Fourier type.

Léon Beschkine : The general solution of rectangular plates (plane problems).

Jean Roubaud-Valette : A generalization of the operation of Dirac.

Georges Darrieus : A new form without singularities of the electrodynamic of Born.

Alexandre Dufour and Fernand Prunier : The observation of the Sagnac phenomenon by an immobile observer.

Jean Lecomte, Henri Volkringer and Arakel Tchakirian : The infra-red and Raman spectra of the chlorobromomethanes.

Pierre Mesnage : The molecular emission spectra of some metallic salts.

H. Bizette and M. Schérer : Anomalies of the magnetic rotatory dispersion of sulphuric acid solutions of tellurium.

Maurice Cotte : The calculation of the influence of the space charge in electronic optics.

Jacques Solomon : The origin of the quadripolar moments of the atomic nuclei.

Maurice Dodé : The dissociation of native zinc carbonate, a reaction in which a mixed condensed phase intervenes.

René Delaplace : The vapour pressure of gaseous saturated hydrocarbons at low temperatures in the presence of silica gel. Pressures are given for methane, ethane, propane, normal and isobutane at temperatures ranging from −25° C. to −171° C. Some quantitative separations of these hydrocarbons can be carried out by this method.

Jean Cournot and Mlle. Louise Halm : Studies on the corrosion of magnesium and some ultra-light alloys protected by deposits on the surface.

Mme. Léone Walter-Lévy : Magnesium basic chlorocarbonate.

M. Lemarchands and P. Pierron : The action of bromine on yellow mercuric oxide.

Maxence Meyer : The thermal decomposition of the $\alpha\alpha$-diethoxydiacids.

Julien Durand : The major irregularities of the crystalline country of Rouergue and of Albigeois.

René Abrard and Edgar Aubert de la Rüe : The existence of the upper Neogene with *Cycloclypeus* at the islands of Epi and Malekula (New Hebrides).

Eugène Raguin and Henri Vincienne : An exceptional (hypothermal) type of lead-bearing deposit in the Montagne-Noire.

Mlle. Jane Manuel : The sexuality of the principal species of the genera *Saccharomyces*, *Hansenula* and *Pichia*.

Louis Bounoure : The constitution of the genital glands in the russet frog after extensive destruction of the germinal line by the action of ultra-violet rays on the egg.

Georges Carrière, Pierre Jean Gineste and Emile Laine : The action of the thyroid body on the thymus.

Stephan Jellinek : Cells with regular geometric deformations without traces of heat action. The action of ultra-short waves (6 metres, 500 watts) on the larvæ of *Salamandra maculosa*.

Moscow

Academy of Sciences, *C.R.*, **15**, No. 3, 1937.

N. Achyeser and M. Krein : The best approximation of periodic functions derived by summation of trigonometric series.

H. Hilmy : The theory of quasi-minimal ensembles.

R. O. Kuzmin : The distribution of values of some arithmetical functions.

B. Fessenkoff : (1) Eclipses of the moon and the distribution of atmospheric ozone. (2) The infinite universe and the luminosity of the night sky.

N. A. Šišakov : An investigation of structures of silica glass, pozzolans and clays by means of electron diffraction (see also Nature, May 29, p. 927).

S. Šubin and A. Smirnov : The scattering of light by the electrostatic field of a point charge from the point of view of the non-linear quantum electrodynamics.

L. I. Belajev : Pseudo-extraction and some specific properties of films obtainable thereby.

M. I. Dementjeva, A. V. Frost and E. K. Serebriakova : Equilibrium hydrogenation of n-butylenes to butadiene, $n\text{-}C_4H_8 \rightleftharpoons C_4H_6 + H_2$.

A. S. Serebrovskij : Analysis of the allobalance of a chromosome by two markers. Utilization of several quantitative characters simultaneously.

M. F. Ternovskij : Amphidiploid shoots of the F_1 hybrid *Nicotiana tabacum* L. × *N. sylvestris* Speg. et Comes.

V. P. Ostrjakova-Varšaver : *Galleria melonella* L. as a new material in genetical investigations.

O. J. Sobolevskaja and V. S. Butkevič : Formation of citric acid in the makhorka leaf (*Nicotiana rustica* L.).

Forthcoming Events

British Association for the Advancement of Science (Nottingham Meeting).

Sunday, September 5

At 8.15 p.m.—Prof. H. Hartridge, F.R.S.: "Illusions of Colour" (Public Lecture at Nottingham).

Monday, September 6

At 10 a.m.—Prof. D. Brunt, Dr. K. C. Lange, Prof. V. Vaisala: "The Upper Atmosphere" (Symposium: Section A).

Dr. Irving Langmuir, Dr. H. Eyring, Prof. H. S. Taylor, F.R.S., Prof. E. K. Rideal, F.R.S., Dr. J. F. Danielli, and Dr. H. J. Phelps: "Surface Action in Biology" (Joint Symposium: Sections A, B and I).

Prof. A. Plant, Prof. B. F. Shields, H. T. Weeks, H. G. Selfridge, jun.: "Retail Distribution" (Discussion: Section F).

Dr. W. B. Turrill, W. J. C. Lawrence, Prof. J. R. Matthews, Dr. T. J. Jenkin and Dr. J. W. Gregor: "Genetics and Taxonomy" (Discussion: Section K).

At 11.30 a.m.—Prof. H. Levi, J. Sargent and J. Wickham Murray: "Technical in Relation to General Education" (Discussion: Section L).

At 2 p.m.—Prof. P. M. Roxby, Dr. L. Dudley Stamp and Prof. C. B. Fawcett: "Culture Regions" (Joint Discussion: Sections E and H).

At 7.30 p.m.—T. M. Herbert: "The Transport of Food (Public Lecture at Newark-on-Trent).

At 8 p.m.—Sir Gilbert Walker, F.R.S.: "The Mechanics of Sport" (Public Lecture at Derby).

Dr. J. E. R. Constable: "Science in Everyday Life" (Public Lecture at Long Eaton).

At 8.30 p.m.—Prof. J. Gray, F.R.S.: "The Mentality of Fishes" (Evening Discourse).

Tuesday, September 7

At 10 a.m.—Dr. R. E. Stradling, Dr. F. M. Lea, Dr. J. S. Dunn, F. H. Clews, H. H. Macey and Dr. G. R. Rigby, Dr. D. G. R. Bonnell: "Chemistry of Building Materials" (Symposium: Section B).

Prof. Winifred Cullis, Dr. H. Magee, Prof. R. C. Garry, Dr. L. P. Lockhart: "Physiology as a Subject of General Education" (Section I: Discussion).

Sir John Russell, F.R.S., Dr. Winifred Brenchley, W. Davies, G. E. Blackman, and Mr. Martin Jones: "Pasture Problems" (Joint Discussion: Sections K and M).

At 8 p.m.—Dr. L. Dudley Stamp, Prof. H. L. Hawkins, F.R.S., Dr. J. S. Huxley, Prof. E. J. Salisbury, F.R.S., Sir Daniel Hall, K.C.B., F.R.S., Prof. J. H. Jones: "Planning the Land of Britain" (Joint Discussion: Sections C, D, E, F, K and M).

Institute of Metals, September 6–9.—Annual Autumn Meeting to be held at Sheffield.

September 6, at 8.—Dr. D. R. Pye, F.R.S.: "Metallurgy and the Aero Engine" (Autumn Lecture).

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Engineer in the Research Department, Woolwich, S.E.18—The Chief Superintendent (September 10).

Lecturer in Mining Engineering in the Denbighshire Technical Institute, Wrexham—The Secretary and Director of Education, Education Offices, Ruthin (September 11).

Crombie-Ross Lecturer in Psycho-Pathology in the University of Aberdeen—The Secretary (September 15).

Junior Lecturer in Physics in the Military College of Science, Woolwich, S.E.18—The Commandant (September 17).

Demonstrator in Chemical Pathology in the University of Leeds—The Registrar (September 18).

State Chemist for Ireland—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (September 24).

Assistant in Biochemistry in the University of Oxford—The Whitby Professor of Biochemistry (September 20).

Junior Assistant in the Science Museum Library—The Director, Science Museum, South Kensington, S.W.7 (October 4).

Lecturer in Physics and Mathematics in the College of Technology and Art, Rotherham—The Director of Education, Education Office, Rotherham.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1936. Pp. v+235. (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [118

National Institute of Poultry Husbandry. Bulletin No. 13: Table Duck Production. By A. J. Macdonald and Joan W. T. Kay. Pp. 12. (Newport, Shropshire: Harper Adams Agricultural College.) [118

National Advisory Council and the Grants Committee for Physical Training and Recreation. National Fitness; the First Steps. Pp. 24. (London: H.M. Stationery Office.) 2*d*. net. [118

National Institute for Research in Dairying, 1912–1937. Twenty-fifth Anniversary Review. By the Staff of the Institute. Pp. 59+xxi. (Shinfield: National Institute for Research in Dairying.) [128

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1764 (2509): On the Application to Tubular Frameworks of the Method of "Systematic Relaxation of Constraints". By Macdonnell W. Woods and E. J. Warlow-Davies. Pp. 22. 3*s*. net. No. 1765 (2467): On Reynolds Numbers of Transition. By A. Fage. Pp. 14. 2*s*. net. No. 1767 (2706): Abstract of a Film illustrating the Theory of Flight. By Dr. H. C. H. Townend. Pp. 8+8 plates. 8*s*. net. No. 1769 (2713): Induced Drag due to Washout. By C. N. H. Lock. Pp. 5. 1*s*. net. No. 1773 (2628): Note on the Design of Corners in Duct Systems. By Dr. G. N. Patterson. Pp. 16+1 plate. 2*s*. 6*d*. net. (*London*: H.M. Stationery Office.) [168

Graduate Employment: a Report of the 1937 Congress of the National Union of Students of England and Wales and the Preparatory Investigation for the Congress. Pp. 94. (London: National Union of Students.) Free. [168

Department of Scientific and Industrial Research. Report of the Building Research Board; with a Report of the Director of Building Research for the Year 1936. Pp. vi+210+25 plates. (London: H.M. Stationery Office.) 4*s*. net. [168

Ruskin and Brantwood: an Account of the Exhibition Rooms. By J. Howard Whitehouse. Pp. 44+8 plates. (Bembridge: Ruskin Society.) 2*s*. net. [168

Other Countries

Koninklijk Nederlandsch Meteorologisch Instituut. No. 102, Mededeelingen en Verhandelingen, 40: Het Klimaat van Nederland (The Climate of the Netherlands). F: Zonneschijn en Bewolking (Sunshine and Cloudiness). By Dr. C. Braak. Pp. 52. ('s Gravenhage: Rijksuitgeverij.) 0.50 fl. [138

Sudan Government: Agricultural Research Service. Report of the Government Chemist for the Year 1936. (Chemical Section, Publication No. 79.) Pp. 17. (Khartoum: Agricultural Research Service.) [138

Latvijas Valsts Meteorologiskais Birojs (State Meteorological Bureau of Latvia). No. 3: Pēdējo divu 30 gadu periodu (1871–1900 un 1901–1930) vidējo gaisa temperātūru salīdzinājums (Mean Air Temperature Differences between last two 30 Year Periods). By J. Barlotl. Pp. 14. No. 4: Gaisa temperātūra Latvijā (Air Temperature in Latvia). Daļa (Part) 1: Gaisa vidējā temperātūra (Mean Air Temperature). By J. Barlotl. Pp. 82. III: Meteoroloģisko novērojumu Gada grāmata (Meteorological Observations Year Book) 1933. Pp. 48. (Rigā: L[illegible] Valsts Meteorologiskais Birojs.) [138

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 69: Observations on some Wool Samples from North-Eastern Asia. By H. Munz. Pp. 23+8 plates. (Melbourne: Government Printer.) [168

Institut des Parcs Nationaux du Congo Belge. Exploration du Parc National Albert, Mission G. F. De Witte (1933–1935). Fascicule 1: Introduction. Par G. F. De Witte. Pp. 39+32 plates. Les Parcs Nationaux et la Protection de la Nature. Pp. 68. Aspects de végétation des Parcs Nationaux du Congo Belge. Serie 1: Parc National Albert. Vol. 1, Fascicules 1–2: Aperçu général de la végétation. Par W. Robyns. Pp. 42+12 plates. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [168

City of Durban. Jubilee of the Durban Museum, 1887–1937. Pp. 39. (Durban: Durban Museum.) [168

Archivos da Fundacao Gaffrée e Guinle, 1936–1937. Pp. iii+228+13 plates. (Rio de Janeiro: Rodrigues e Cia.) [178

Catalogues, etc.

Dunns Seed Wheats, 1937. Pp. 32. (Salisbury: Dunns Farm Seeds, Ltd.)

Beck Spectroscopes and Spectrometers. Pp. 16. (London: R. and J. Beck, Ltd.)

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Research and Industry

IN his presidential address on September 2 to Section G (Engineering) of the British Association meeting at Nottingham, Sir Alexander Gibb took for his subject "Research and Engineering". He pointed out that engineering began as an art; at a later stage it developed into a somewhat scientific but purely empirical practice ; and that it is now at the final stage of applied science. The same transformations may be noted in many other industries, though it must be admitted that there is still a great number of industries yet in the second stage of development, and some even in the first. Nevertheless, there is an increasing attention paid in industry generally—and not only in engineering—to the vital necessity of continuous research as being, to quote the words of Sir Alexander, "the only means of continuous progress in an increasingly competitive world".

Sir Alexander Gibb gave a necessarily brief historical survey of the rise and development of research, which is a plant of very recent growth. Apparently he regards the beginnings of the national recognition of the value of research as dating back to less than a century ago, when the Royal Commission was appointed to find uses for a surplus of £213,000, made by the Great Exhibition of 1851. The money was used to purchase land in Kensington Gore, on which were built museums and schools of art, and also to provide science scholarships. Government grants from 1850 onwards to the Royal Society and private donations or bequests went to aid research in mathematics, physics, astronomy, biology, chemistry and general purposes.

In Great Britain, throughout this early period, original research continued to be mainly the work of individual scientific workers and was carried on chiefly at their own expense. Industry lagged far behind in its recognition of the value of scientific research, and it may be said, indeed, that it is only within very recent times that industry generally has accepted the view that scientific and industrial research is an essential factor in our industrial and national existence. It is also true to add that it needed the lessons of the Great War to open fully the eyes of the Government to the paramount need of systematic scientific research in our industrial organization.

Perhaps nothing in the development of the research movement is more significant than the way in which the distinction between pure and applied science, which was originally as sharp as the distinction between 'Gentlemen' and 'Players' at Lord's, has gradually lost its sharpness and become vague and indefinite. It is not so very long ago that, in many quarters, research into the internal structure of the atom was regarded as a noble and elevating pursuit of pure science, and research on soap as a rather ignoble, if not degrading, investigation—as though an atom were inherently dignified and became disreputable only when it was associated with other atoms to form the molecules of a homely, if necessary, commodity. Indeed, the artificial division between pure and applied science has dissolved perhaps most rapidly in the very laboratories which may seem, at first sight, to have been designed to buttress and perpetuate it. In industrial research laboratories, both at home and abroad, there is abundant testimony to the importance of 'pure science' research—what it is now the fashion to call 'fundamental research'.

The same recognition is a remarkable feature of the experience of those industrial research associations which have been formed under the ægis of the Department of Scientific and Industrial Research. Almost with one voice they are crying out that the time and energies and the expenditure involved—necessarily and rightly involved—in solving *ad hoc* problems of great and immediate importance to the respective industries, leave them with too little time and energy and funds to be devoted to that fundamental research which they recognize as equally vital to the progress of industry. The solution, let it be said at once, demands not the curtailment of one to make possible the enlargement of the other, but adequate funds to enable both *ad hoc* and fundamental research to be pursued on a sufficient scale.

We may note here that Sir Alexander Gibb says: "There is what one may call true fundamental research—splitting the atom, or extreme low temperature investigation." Perhaps it is convenient to call such research fundamental. It is a little difficult, however, to see how "splitting the atom" is more "fundamental" than splitting the molecule in ordinary industrial cracking processes; or to understand why "extreme low temperature investigation", more than high temperature researches in, say, polymerization or hydrogenation, is "true fundamental research". However, the point is one of small importance. In all cases of so-called industrial research, the ultimate need is nothing less than the full available knowledge of all the factors involved, and these factors include as well those that may conveniently be regarded as 'pure' or 'fundamental' as those of immediate industrial importance. The real aim of industrial research, whether in engineering or in any other industry, should be to elucidate the scientific principles involved, to gain the scientific knowledge needed and to apply the knowledge, in so far as it can be applied, to industrial practice. To achieve these aims it may be necessary to undertake what is called pure or fundamental research, on one hand, and applied research, on the other. But, at bottom, these constitute essentially one research purpose.

Another feature noticed by Sir Alexander in his address is the degree to which, in later years particularly, co-ordination and co-operation in research have become recognized as essential. Sir Alexander quotes the remarks of Mr. Thomas Midgley on the occasion of the award to the latter this year of the Perkin Medal of the Society of Chemical Industry: "In any earlier age, when science and industry were simply individualistic processes, it is conceivable that some person, by his efforts alone, could have advanced applied chemistry to have justified your Committee to bestow upon him the Perkin Medal. To-day this is no longer so; to advance applied chemistry, even a little, requires the organized efforts of many individuals." This is, of course, true also of industry and manufacture in general. The work undertaken by the various research boards of the Department of Scientific and Industrial Research, and the wide field of scientific and industrial research covered by the activities of the industrial Research Associations, all testify to the vital need to-day of co-ordination and co-operation in research. Scientific research is becoming less and less an individual effort and more and more a matter of team work.

Towards the conclusion of his address, Sir Alexander Gibb directed attention to the fact that, the greater the success of research, the more immediate and drastic is the effect on existing plant and equipment. He says: "Millions are necessarily sunk in fixed assets, which may in a year or two be made obsolete by the development of new methods", and he declares that many valuable inventions have been bought up by vested interests and suppressed, in order to save the greater loss that their exploitation would involve to already operating plant. This particular allegation has been made so often that it is difficult to believe there is not a good deal of truth in it. The lack of data of specific instances of inventions being purchased only to be promptly strangled is, however, a great handicap to any assessment of what the nation has lost and may lose by such a practice. Not many years ago, large commercial combinations were regarded with deep suspicion, as being nothing but price rings. But the findings of a Government inquiry into the extension of trade organizations and combinations did a great deal to allay public mistrust. The question arises whether a similar Government inquiry should be made into this alleged practice of smothering valuable inventions at, or soon after, their birth. It might turn out that the practice neither goes so deep nor is so widespread as popular impression allows. On the other hand, if such an inquiry should reveal a grave public mischief, appropriate measures could be taken. From every point of view, however, it is desirable that precise information should be available on this subject.

Cultural Basis of the History of Science

Famous American Men of Science
By J. G. Crowther. Pp. 414 + 12 plates. (London: Secker and Warburg, Ltd., 1937.) 15*s.* net.

SINCE the publication of Prof. Hessen's challenging discussion on the social background of Newtonian mechanics at the International Congress of 1931, there have been welcome indications of a new attitude which may do much to rescue the history of science from the disfavour or indifference of the majority of scientific workers. Prof. Wolf's book has made the famous woodcuts of Agricola's treatises on sixteenth century mining technology accessible to a wide circle of readers. The issue of Hooke's diaries and the reprint of the "Heads of Enquiries" have shed a new light on the early days of the Royal Society. Mr. Dickinson's admirable biography of Matthew Boulton has disclosed a mine of information about the scientific renaissance which accompanied the Industrial Revolution. Not least important of recent literature with this new orientation was J. G. Crowther's "British Scientists of the Nineteenth Century".

One of Mr. Crowther's reviewers compared the latter to Mr. Strachey's "Eminent Victorians". The comparison was a just one in so far as the faintly ironical flavour of the author's style placed it among the class of books which may be read painlessly. From another point of view it was less apt. Mr. Crowther is not a writer of footnotes or a biographer in the gentlemanly tradition. He has a vigorous and a unified point of view about the topics he handles. As Mr. James Branch Cabell used the romantic medium to satirize romanticism, Mr. Crowther uses the art of biography to put the individual in his place. That is not to say that he underrates the exceptional capabilities of the personalities he selects or discounts the magnitude of individual differences. What distinguishes Mr. Crowther's treatment from that of Prof. Lenard and a host of imitators who have raised the conventional cult of the scientific worthy to the status of a historical creed, is that he is pre-eminently interested in what circumstances of his situation enable a man of exceptional gifts to be trained in a particular way, how the conditions of his time canalize his curiosity into some specific and profitable channel and how his social circumstances provide him with instruments for solving the problems he tackles.

Great men do not come trailing clouds of glory from the abode where the eternals are. The human zygote—albeit well favoured with genes—does not attain the stature of international eminence in a social vacuum.

"From the perspective of the history of science," says Mr. Crowther, "the question of personal priority is of no importance. The significant feature of Henry's great paper of July, 1832, is that the phenomenon of electro-magnetic induction was discovered, or about to be discovered, independently at about the same time in Albany, U.S.A., and in London, England. These events show that the progress of science depends far less than is generally believed on the efforts of individual geniuses. . . . As Henry and Faraday made the discovery almost simultaneously, it could not have been of such a unique nature that it could occur only to one investigator of supreme genius."

Mr. Crowther might have made a more topical hit by substituting genes for God when he writes:

"The traditional explanation of why the laws of gravitation were discovered in the seventeenth century is that Newton happened to be born then. As Pope wrote:
'God said: let Newton be, and all was light.'
According to this view, the light of gravitation would have been seen in 1665 B.C. instead of A.D. 1665, if God had chosen to let Newton be twenty-three years of age on the former date."

Mr. Crowther's new book, no less noteworthy than its predecessor, follows the same plan and traverses a less familiar terrain. Its four hundred pages are devoted exclusively to four studies: Benjamin Franklin, Joseph Henry, J. Willard Gibbs and Thomas Edison. It deals, therefore, with a longer period of modern science than its predecessor, and the individual portraits are more detailed. Though it appeared first in its American edition, we may anticipate a wider audience in Britain than in the United States. It abounds in incidents of social history less familiar to men of science in Great Britain than to educated Americans. The selection of personalities, though closely involved in the dominant themes of British science, do not include any representatives of the biological sciences, such as genetics, to which the American contribution has been specially noteworthy. It would be interesting to read what Mr. Crowther would have made of the initial impetus which American biology received from the expansion of agricultural technology during the latter half of the nineteenth century. To regret that he has not done so is a tribute to, rather than a criticism of, the book as a whole. The range of Mr. Crowther's knowledge and the discrimination with which he writes encourages us to ask for more.

The social background of science is so complex that two writers might well handle the same period with great detail and very little overlapping. Some of the main issues which confront the historian of science may be summed up in the triadic formula familiar to readers of crime fiction. The tempo of scientific progress receives new *motive* power from new problems which arise in the technique of navigation, mining, agriculture and other forms of production. New technical amenities, such as the manufacture of cheap and abundant glass of high transparency or the production of cheap amplifiers, provide the *means* for tackling problems which have defeated renewed efforts in the past. New social machinery for the recruitment of a new fund of social personnel—schools and academies, organized professions and scholarships—make *opportunities* for enlisting talent in the solution of new problems. One of the advantages of the biographical treatment which Mr. Crowther follows is that it does not commit him to concentrate on any one aspect of the social background of science to the exclusion of others. At one moment he dwells on the special climatic conditions which favoured Franklin's work on atmospheric electricity. At another he examines the influence of railroad extension on American contributions to electrical communications. Throughout the book he sustains a keen appreciation of the interplay of commercial and professional preoccupations in providing the means of livelihood for scientific workers.

The interest of Franklin for the student of scientific history extends far beyond the fact that he brought the first electrical invention into economic use. The Philadelphia Academy is a halfway house between the Invisible College and organizations such as the Edinburgh Society or the Lunar Society of Birmingham. Franklin, whose interest in electricity was inspired by the work of Hawksbee, Gray and Watson, had close personal contacts with Priestley, Boulton and other notables of the Edinburgh and Birmingham circles. Mr. Crowther insists that his political career and his scientific interests were different facets in the same social pattern. The further advancement of science was then contingent on the rising social influence of the entrepreneur, and drastic political changes were essential to establish it. There is much in the history of the time to show that this view was shared by many scientific men. Both the Lunar Society, among whom Priestley was elected a member of the National Convention and a delegate for the Department of Orne, and the Manchester Literary and Philosophical Society, when the elder Henry was one of its leading figures, sent official representatives to the Club of the Jacobins.

In the essay on Joseph Henry, first director of the Smithsonian Institution, Mr. Crowther's narrative puts the first beginnings of wireless communication in a new setting, and provides a useful corrective to reiterated emphasis on the cardinal incentive which Maxwell's theory is supposed to have supplied. Starting with Henry's experiments and Varley's lightning protector, the history of radio might well be rewritten from the record of workshop discoveries in connexion with microphone construction with much less reference to the parallel mathematical development of wave-theory.

Like Lytton Strachey, Mr. Crowther has the knack of selecting a situation which is ironical in its own right and needs no comment to embellish it. Such is the story of James Smithson, whose will provided for starting what Taft called "the incubator of American science". Such also are many of the well-authenticated incidents from Edison's history. The following is a sample:

> "He made his first invention at Stratford when he was sixteen years old. Night operators were required to send hourly signals to show they were awake. He devised a clock which made the time signals automatically. This enabled him to sleep while on duty and preserve his energy for his own interests during the daytime."

When Edison started putting up telegraph lines between private business offices to exploit his alphabetical dial instrument, he himself says that they slung wires over the house-tops "without asking anyone's permission. Apparently they went to houses and stores which had already had wires supported by the roofs, and told the occupants they were the telegraph men and wanted to see the wires. They were always given permission to go up to them, and while there fastened up their own. This, apparently, is how it was possible for Edison, without any capital, to put up his own small centralised telegraph system in the center of a city. He did not pay rent for the wires slung over the property of others".

The importance of the new school to which Mr. Crowther belongs is that it gives the history of science a new cultural status. The future of scientific progress is not assured by its own momentum. In the past there have been Dark Ages. The recent exodus of scientific men from Germany shows that the prestige of science is more precarious than many would like to believe. In some small measure no doubt the choice between progress and decay can be influenced by scientific workers as citizens equipped with understanding of agencies which decide the stability of a social culture. Only as an integral part of the story of man's social relationships can the history of science give them this understanding. As such Mr. Crowther's book has a wide appeal and claims a large audience. Among men of science it should arouse a new sense of social responsibility. Among those who have received a humanistic education it should stimulate a new interest in science.

L. T. H.

Science and the Modern Highway

Principles of Road Engineering

By Prof. H. John Collins and C. A. Hart. (The Roadmakers' Library, Vol. 6.) Pp. xvi + 628 + 21 plates. (London: Edward Arnold and Co., 1936.) 50*s*. net.

ALL branches of applied science have made rapid progress during the last quarter of a century, and not least that of the science of road building. During this time, we have seen the transformation of our roads from the dusty and pot-holed surfaces of the horse-driven carriage and early motor age to the smooth and clean highways of to-day, and with it the very face of England has also changed in a way that at one time would have been deemed impossible. Physics, chemistry and geology have all been pressed into the service of the highway branch of civil engineering, so that it has been transformed from empiricism to something approaching an exact science.

Great Britain has so far lacked a treatise which deals clearly yet briefly with the principles of highway engineering; the book produced by Prof. Collins and Mr. Hart, linking as it does the more specialized works which form the "Roadmakers' Library" in such an admirable manner, is therefore peculiarly welcome. Its merits are well considered with respect to the series of which it forms a part, since this is intended in course of time to cover the whole field of roadmaking and at the same time to make some reference to present policy in Great Britain regarding the development of our highway system. Thus the taking over of the thousands of miles of trunk roads by the Government —only a proposal when this book was published— is now an accomplished fact, and we may perhaps have yet more far-reaching changes in policy, since the Trunk Roads Act of 1936 was criticized from the Government benches as not going far enough.

For years past, the vexed question as to whether Great Britain should have an entirely new road system, as in the case of Germany and Italy, or whether her roads should be improved by the process of widening, bridge construction and the making of by-passes, has been hotly debated. The latter represents the official view, and it is greatly to the credit of the book under review that it is so designed as to be capable of use under either policy.

The book opens with a short, interesting history of the development of our present road system, rightly stressing the lack of foresight shown by those responsible. An account of the evolution of the various forms of surfacing follows, and the thorny subject of road accidents is dealt with in a very readable way, the necessary statistics being kept to a minimum. This part of the work leads naturally to a consideration of the factors affecting skidding, corrugation and noise, with an able treatment of economic considerations such as the relation between gradient, type of surfacing and running costs.

The principles of route location are illustrated by reference to the Ballachulish-Dochfour and the new Glencoe roads, the only important works of the kind which have been carried out in Great Britain since the Great War. The value of this part would perhaps have been increased if at least one foreign example of completely new location had been included, though the omission is understandable in view of our present policy of patching an old garment rather than investing in a new suit.

The geological section is clearly set out, the illustrations, here and in the other parts of the work, being most useful and well reproduced. It is unfortunate that the portion dealing with the use of local materials is quite inadequate. Great attention has been devoted to this matter in Canada and the United States, where geology has been applied to engineering problems in a way undreamt of in Great Britain, and a survey on these lines has been carried out in the case of the new Glencoe road, though not by official geologists.

Methods of carrying out preliminary, Parliamentary, location and construction surveys follow, and can be commended, though many readers will probably agree that Chapters ix and x, dealing with surveying proper, could with advantage have been omitted. It is to be supposed that all graduates in civil engineering will have covered the work given in these chapters in their university course, though this criticism may not apply to the matter dealing with aerial surveying. Surveying for private streets is incompletely described, especially in view of the many legal and other difficulties which beset the paths of the local authorities responsible for the construction of many hundreds of miles of such roads yearly.

Horizontal and vertical curves, so important in view of the ever-increasing speeds of modern traffic, are covered in Chapters xi and xii, as is the subject of super-elevation, the variable super-elevations used in racing tracks being very properly condemned as being unsuitable for highways carrying mixed traffic. It is thought, however, that the two pages given to proving a formula used in work of this kind could well have been omitted and the space devoted to such common matters as the widening and improvement of highways, subjects which are not dealt with. The methods of lay-out of road junctions and crossings show the circular type of roundabout now favourably considered by the Ministry of Transport, though it is thought that one of the Y-junctions shown is capable of improvement. Earthworks, including the application of the valuable mass-haul curve, and drainage works, are well covered, though not all engineers will agree that the Ministry of Health formula for run-off gives satisfactory results, more particularly in the case of small areas of ground.

Road foundations and soil mechanics receive detailed attention, the work under the latter head comprising the results of researches not easily available to practising engineers. It is surprising to find no mention in this section of pitched or hard-core foundations, widely used in road construction generally, while the description of construction of concrete roads would probably have been more useful had diagrams and photographs showing arrangements of forms and other such details, been included. The debatable question of reinforcement in concrete roads is treated from a rational point of view, since this problem still awaits elucidation.

Chapter xviii is disappointing, important surfacings such as water-bound macadam, tarmac and sett paving each being dismissed in a page, footpaths—so much to the fore at present—in a few lines, and the data regarding surface dressing are similarly brief. On the other hand, four pages are devoted to a somewhat arid report of the Metropolitan Paving Committee. It is also questionable whether the nine pages of condensed highway law given in Chapter xix are of much value to the highway engineer, especially since the series of which the work forms a part contains an entire volume on the subject. One also looks in vain in either this treatise or the series as a whole for a really good account of highway administration, dismissed in a few pages in the first volume, which in this respect somewhat belies its title.

It would be invidious to over-stress points of this sort in considering a work dealing, as its title states, with the principles of highway engineering, and the authors are to be congratulated on having encompassed so vast a subject in so comprehensive, readable and authoritative a manner. Their treatise can be justly described as a real achievement and a marked contribution to scientific knowledge.

B. H. KNIGHT.

Indian Hydro-electric Technics

The Hydro-electric Practice in India

By Prof. Bhim Chandra Chatterjee. In 2 vols. Vol. 1. Pp. xi + 576 + vi. Vol. 2. Pp. v + 577–1168 + vii. (Benares City: Shiva Narayan Chatterjee, 1936.) 50 rupees.

WRITTEN with an Indian purview by an Indian for Indian students, and produced from an Indian press, it is not altogether easy, nor perhaps quite fair, to judge these two substantial volumes by Western standards. The author is professor of electrical engineering at Benares Hindu University and he has had in mind the B.Sc. course for engineering students at that University, though his object has also been "to guide the engineers entrusted with the task of designing and constructing hydroelectric developments or reporting on their commercial success". He has illustrated the principles of his subject by reference to current practice in the most important hydro-electric schemes of India. At the same time, he indicates that he has drawn freely from all sources of information; and data and a few particulars are given of installations in Canada, the United States and Great Britain.

This being so, it is a little surprising that in a "Comparative Statement of Dams in the World" (p. 832), the only American example quoted is the New Croton Dam (which, by the by, appertains to a water-supply reservoir) and no reference is made to the outstanding examples of water-power dams at Grand Canyon (Boulder Dam) Grand Coulee, Bonneville and other recent American enterprises, or to the Chambon Dam in France and others elsewhere. Furthermore, the use of the term "unprecedented" from a report (dated 1910) in connexion with the Cauvery River

(Mettur) Dam might dispose the reader, in the absence of comment, to infer that a height of 200 ft. or so combined with a length of 5,300 ft. constitutes something unique, whereas the Grand Coulee Dam, though not quite so long (4,300 ft. crest length), has the much greater height of 550 ft. Recent instances of this kind relating to dams of great magnitude should scarcely be overlooked in an up-to-date treatise.

The author certainly deals with his subject in full and commendable detail. He commences with a good chapter on the conditions, financial and economical as well as physical, under which a hydro-electric development project may be considered feasible. Then he proceeds expertly to the theoretical aspect of the matter, surveying the field of hydrology and hydraulics, explaining the nature and purpose of structural features and plant equipment, winding up with a section of 500 pages (nearly half the contents of the whole work) on hydro-electrical installations in India, and a few notes on management. Among the installations described are the Tata, Cauvery, Kashmir, Mandi and Andhra.

There is, in fact, an immense amount of information comprised in the sixteen chapters of which the work is composed, a good deal of it quoted from various sources, with the limits of quotation not always clearly defined. The index is moderately good. The print is bold and readable, but a number of typographical errors are in evidence. The photographic illustrations might be clearer and some of the diagrammatic figures are blurred. The block on page 846 is upside down! In comparison with other publications of similar origin, the production is apparently up to Indian printing and book-binding standards, but there is certainly scope for improvement in these respects. Taken as a whole, the work should achieve its purpose as a serviceable manual for the Indian student, and, indeed, be of undoubted value for general reference.

B. C.

Keeping Pace with Physics

The Physical Society
Reports on Progress in Physics, Vol. 3. General Editor: Allan Ferguson. Pp. iv+394. (London: Physical Society, 1937.) 20*s.* net.

THE annual output of papers in physics, including certain branches of electrical science, is at least six thousand. Few if any libraries contain all the original journals, and the time taken up by research, teaching and administration leaves far too little for the physicist to deal unaided with the bulk and diversity of published papers. Monthly classified abstracts are given in *Science Abstracts* and in *Physikalischen Berichte*. The subscriber to these journals receives each month about 480 fragments of physics in the making, from which he selects the few relevant to his own work and uses them as a guide to the original papers. Some kind of co-ordination of the results of the remainder of papers is needed by all who wish to keep pace with current physics.

The Physical Society's "Reports" are designed to cover most branches of physics at yearly intervals, and some special topics after longer periods. This third volume maintains the high standard of the two previous volumes without quite solving the two difficult problems of uniformity of treatment and freedom from overlapping. For example, sound is covered by an excellent 24-page article giving 78 references. The following article on the measurement of noise occupies 18 pages, gives no references, is written in the style of an advanced popular science lecture and overlaps the sixth section, technology, of the previous article. Each article is excellent of its kind, but the standard of previous knowledge needed to read the two is quite different. The overlapping is no mere repetition, but is wasted when the volume is used for reference, as there is no index. Contributors, unable to meet and discuss, cannot be held responsible for these two characteristics of the reports, but an editorial committee could perhaps help by issuing more detailed instructions formulated to guide the individuals.

Since the reports can be prepared only by experts, any avoidable overlapping is a waste of part of the world's science man-power. From this broader point of view overlapping with independent publications is also to be avoided. For many years the Chemical Society in its "Annual Reports" has issued excellent reports on crystallography. Why then has another group of workers been set the task of preparing for this volume another independent report in which the same subject is covered, as it happens, less adequately? The Chemical Society "Reports" deal also with radioactivity and sub-atomic phenomena. If it be urged that the reports are prepared from different points of view, it may equally well be urged that if physical aspects of phenomena are relevant to chemistry, then chemical aspects are relevant to physics.

At present, to keep pace with physics it is necessary to consult the "Reports" of the Physical and Chemical Societies, the *Reviews of Modern Physics*, *Chemical Reviews* and *Die Physik*. With the persistence of the Government restrictions placed upon science, German periodicals will become less and less important. To avoid duplication it is therefore necessary to secure co-operation between only English-speaking societies.

The Physical Society is already broadminded enough to adopt in its *Proceedings* an indexing system designed to help in the international co-ordination of knowledge. Is it too much to hope that the Society will also try to secure the co-operation necessary to present an annual report holding a unique position in journals published in English? Even the present "Reports" are indispensable in any science library, and readers are heavily indebted to the many individual contributors who have had to sacrifice some of their research effort to carry out the arduous task of digesting hundreds of research papers.

W. H. George.

Light in the Service of Man

Allgemeine Photochemie:
ein Hand- und Lehrbuch für Studium und Forschung für Mediziner, Biologen, Agrikulturchemiker, Botaniker, usw. Von Prof. Dr. J. Plotnikow. Zweite, umgearbeitete und erweiterte Auflage. Pp. viii + 909. (Berlin und Leipzig: Walter de Gruyter und Co., 1936.) 28.50 gold marks.

PROF. J. PLOTNIKOW, who has considerable experience in theoretical and applied photochemical research, has dealt with different aspects of photochemistry satisfactorily in this treatise under notice. He has divided the subject-matter into four sections, namely: (1) sun and mankind; (2) interaction of matter and radiation energy; (3) statics and dynamics of light reactions; (4) different reactions caused by light.

In the first section, the characteristic properties of different radiations (for example, infra-red, visible, ultra-violet, etc.) and the problem of sight are described in detail. In the same section, the subject of nutrition in the future has been considered in an interesting manner from the point of view of the photochemist. A brief historical account of the development of photochemistry from ancient times appears at the end of this part.

In the second section, the laws of light absorption, reflection and scattering, the phenomena of fluorescence, phosphorescence, bioluminescence, etc., the laws and mechanism of photochemical reactions, temperature coefficient, quantum yield and allied problems, are discussed. It is interesting to note that the summary of quantum yields of different photochemical reactions recorded on pages 230–231 shows that the Einstein law of photochemical equivalence fails in the majority of reactions investigated so far. This fact has also been emphasized by the reviewer.

The mathematical aspect of photochemistry is considered in the third part of the book. The experimental technique of photochemical reactions, which has been considerably developed by Prof. Plotnikow and co-workers, is also discussed in this section. Cases of photochemical catalysis and equilibrium and the relation between the intensity of the incident radiation and the velocity of photochemical reactions have also been included.

In the fourth part, the author describes briefly numerous photochemical reactions involving inorganic and organic compounds. Most of the literature in photochemistry has been condensed in this section, which also contains a good account of the mechanism of photosynthesis in plants and the function of chlorophyll. Photolysis and photo-oxidations are also adequately considered. At the end, work on the sensitization of photographic plates and films to various parts of the spectrum is summarized: to the infra-red radiation by neocyanine, kryptocyanine, xenocyanine, etc.; to red by dicyanine; to orange red by pinacyanol, nigrosin, chlorophyll, etc.; to orange by pinachrome, cyanine, orthochrome-T, methyl violet, ethyl violet, etc.; to blue green by uranine, acridine yellow, etc.; to ultra-violet by sodium salicylate (alcoholic solution), 'Vaseline' (acetone solution) and other fluorescent substances. A brief account of the phenomenon of desensitization of photographic plates and films with phenosafranine and allied compounds discovered by Lüppo-Cramer has also been included.

As light is utilized in the production of food materials in plants, in nitrogen fixation and in other processes in the soil, in photography, in the production of vitamin, in the treatment of disease and in the preservation of health, in the large-scale sterilization of water and milk, in the detection and testing of different materials, etc., photochemistry is of necessity engaging the attention of numerous workers all over the world, and several important books on this topic have recently been published. The present comprehensive work by Prof. Plotnikow is a valuable contribution to knowledge and should be widely read by chemists, physicists, biologists, agriculturists, medical men and others interested in this subject, which has great possibilities.

N. R. Dhar.

Soil Erosion and its Control

By Prof. Q. C. Ayres. (McGraw-Hill Publications in Agricultural Engineering.) Pp. xi+365. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 21*s.*

ONE of the effects of the recent world depression has been to focus attention on problems of soil erosion. This has been the case particularly in the United States of America. The preceding years of high prices had led to a rapid expansion of mechanized farming, thereby reducing the man-power required to farm arable land. So long as prices ruled high, little notice was taken of the diminishing returns obtained from such expansive and continuous cropping, but as soon as the bottom fell out of the market, farmers discovered, almost overnight, that they could no longer carry on.

It was soon made clear that this was largely due to soil erosion and that the damage thus caused was increasing at an alarming rate. Whereas in 1910 it was estimated that ten million acres of farm land were ruined and abandoned, this figure had increased by 1935 to between thirty-five and fifty million acres. For years previously that "tireless little band of erosion technicians" to whom this book is dedicated, had been as a voice crying in the wilderness, and it required the effects of the depression forcibly to bring the position to the notice of the administration, which lost no time in forming this band of workers into the nucleus of a Soil Conservation Service. This Service, besides continuing research, was able to find employment for large numbers of farm workers and other unemployed in an endeavour to control soil erosion.

Since the initiation of this Service, much has been published in the form of bulletins, leaflets, etc., on soil erosion and its control. The author of the present work has collected and arranged this information under suitable headings, and the diagrams, tables, charts and numerous illustrations add much to the value of the text. Though based entirely on American experience and American farming conditions, the book should prove of value to those in other lands where somewhat similar problems and circumstances prevail.

Revisiting my Pygmy Hosts

By Paul Schebesta. Translated from the German by Gerald Griffin. Pp. 288+31 plates. (London: Hutchinson and Co. (Publishers), Ltd., 1936.) 18*s.* net.

AFTER two visits to the pygmies of the Congo in 1929 and 1930, Dr. Schebesta found himself constrained to pay them a third visit to obtain supplementary data. On this occasion his objective was in the area of Lake Albert and his hosts the Bambuti, as they call themselves. He has thus completed the tour of both the eastern and the western pygmies.

In this story of his sojourn among the little people of the forest, the author has purposely omitted any formal account of organization and culture where it does not differ from that described in his earlier work. Here again negroes and pygmies live in a relation in which each supplies something lacking in the economy of the other. The negroes need meat and the pygmy hunter supplies it: in turn, the pygmy needs bananas and vegetable produce, which is obtained from the negro gardens lacking in the pygmy culture.

Dr. Schebesta's lively picture of his relations with his pygmy people affords his readers an opportunity of appreciating their mentality. He has also taken full advantage of his informal method of description to demonstrate the actual working of their social and cultural organization and their magico-religious beliefs. The author is more than ever convinced that the culture of the pygmy is of purely forest origin, and that they are its aboriginal inhabitants.

Exercices d'analyse

Par Prof. Gaston Julia. Rédigés par Dr. Georges Bourion. Tome 4: Équations aux dérivées partielles du premier ordre. Pp. v+230. (Paris: Gauthier-Villars, 1935.) 60 francs.

THIS is the author's fourth volume of exercises in analysis. It is devoted mainly to partial differential equations of the first order, and consists of a discussion of some 55 problems taken from examination papers set at the Sorbonne for the Certificate in Calculus and from Part II of Édouard Goursat's "Course in Mathematical Analysis". The questions selected range from total differential equations to be solved by Bertrand's method, to simultaneous systems and problems in geometry involving partial equations. The solutions are not only complete, but also are characterized by their clarity and elegance. In nine cases, alternative methods, geometrical and analytical, are considered, whilst problem 53 is provided with three solutions. Relevant extensions, particular cases and applications are also indicated wherever possible.

To teachers and students of differential equations, this book should be extremely valuable.

F. G. W. B.

A Marriage Manual:

a Practical Guide-Book to Sex and Marriage. By Dr. Hannah M. Stone and Dr. Abraham Stone. English edition edited, and with an Introduction by, Michael Fielding. Pp. 352. (London: Victor Gollancz, Ltd., in conjunction with John Lane, The Bodley Head, Ltd., 1936.) 7*s.* 6*d.*

THE admirable little work by Dr. Hannah M. Stone, medical director of the Birth Control Clinical Research Bureau of New York and Marriage Consultation Centre, and Dr. Abraham Stone, surgeon to the Sydenham Hospital and director of the Marriage Consultation Centre, is written in the form of imaginary conversations between a physician and a young couple about to be married. The subjects on which the pair seek enlightenment are fitness for marriage from the psychological, sexual and eugenic points of view, the anatomy and physiology of the sexual organs, fertility and sterility, prevention of conception, venereal diseases, the art of marriage including the technique of coitus, psychical and somatic incompatibilities and health in marriage. A bibliography of recent English and American literature is appended.

Noise and the Nation[*]

By Dr. G. W. C. Kaye, O.B.E.

SIMULTANEOUSLY with the remarkable growth of applied acoustics, there has gradually developed in Great Britain a public consciousness of the insidious growth of the social evil of needless noise—a pernicious by-product attributable in great part to an increasingly mechanized civilization. With this growing realization, the nation is beginning to demand and to receive protection against the nuisance of outrageous noise whether generated by private or public bodies. It is looking for ways and means of mitigating excessive transport noises, particularly on the road and in the air, and it is seeking to know why in modern houses or flats it should not be accorded adequate privacy against the natural, though sometimes unreasonable, noises of neighbours.

THE MEASUREMENT OF NOISE

It is common knowledge that most noises are complex in character, containing a variety of components which may be distributed over the entire auditory ranges of frequency and intensity. Such a physical constitution lends itself to objective measurement and analysis, but apart from the psychological aspects, there are subjective factors of prime importance to the listener, namely, pitch, timbre and loudness, and these sensations are not readily appraisable. Experience indicates, however, that while the composition of a noise is not to be ignored, sheer loudness is the determining factor in most cases of annoyance caused by noise, so that the problem largely resolves itself into the correlation of the sensation of noisiness (as assessed by the ear) with the associated energy, which can be quantitatively measured by physical instruments.

Let us first consider the measurement of acoustical energy. For the purpose, we need an intensity meter, this commonly consisting of a microphone and amplifier together with a suitable rectifier and indicator. Moving-coil or ribbon microphones are sometimes employed, though for fundamental work the condenser or the crystal microphone is preferred despite the lower sensitivity. Whatever the microphone used, it is usually calibrated by direct interchange comparison under appropriate conditions with a standard (pressure) microphone of the condenser type, which in turn has been fundamentally calibrated in absolute units by means of either the Rayleigh disk or the piston-phone.

The Rayleigh disk depends for its operation on the tendency of a small thin glass disk suspended from its edge by a fine fibre to set itself at right angles to a sound field. The torsional constants of the system and the degree of deflection of the disk afford the sound particle velocity, the corresponding sound pressure being calculable from the known relations in the field. The measurements are made either in a stationary-wave pipe or in a room with highly absorbent walls.

The piston-phone, which measures sound pressures directly, consists essentially of a small cavity, one face of which is closed by the diaphragm of the standard microphone, the opposite face consisting of a small piston connected to the moving coil of a loudspeaker unit. The amplitude of motion of the piston, when it is set in vibration, is measured optically and enables the corresponding sound pressures in the cavity to be calculated.

So much for intensity measurements. As regards the associated loudness levels, we turn to auditory diagrams of the ear, such as those of Fletcher and Munson. The various loudness contours for pure tones of different frequencies show that while loudness and energy are manifestly related, the two do not normally keep in step, particularly for notes of very high and very low frequencies. At feeble intensities, the ear exercises pronounced selective preference for notes of medium frequency, and it is only at high intensities that equal increments of energy produce even approximately equal increments of loudness. Furthermore, the thresholds of hearing are much higher for high and low frequencies, so that the corresponding ranges of intensity with which the ear can deal are more restricted than for notes of medium frequency. The situation is worsened in the case of complex sounds or noises since the loudness is affected by their character, there being in general no simple relation between the loudness of a noise and the energy-loudness characteristics of its several components. It is evident that an energy meter, such as a microphone system, cannot unreservedly be used as a direct measurer of loudness.

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[*] From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Nottingham on September 2.

THE DECIBEL AND THE PHON

The next step in the measurement of noise is to equip ourselves with units and standards of loudness. In this connexion, we have to cater for the enormous intensity range of the ear, particularly for notes of medium frequency, where the greatest intensity that can be tolerated (the threshold of pain) is some 10 million million (10^{13}) times that corresponding to the threshold of hearing. In such circumstances, we turn, as always, to a geometrical rather than an arithmetical scale, and the unit adopted for the purpose is the *bel*, which is a ratio signifying a 10-fold increase in intensity, power or energy. Two bels signify a 100-fold increase, three bells a 1000-fold increase, and so on.

Equipped with such seven-league boots, and starting at a zero approximating to the threshold of hearing, we can traverse the entire auditory intensity range for a medium-frequency note in as few as thirteen geometrically progressive steps. But the steps are too big for practical convenience and so it is usual to speak of a range of 130 *decibels*, which provides a serviceable energy scale. Arithmetically, a decibel (db.) denotes approximately a 5/4 energy increase (that is, antilog 1/10), two decibels a $(5/4)^2$ increase, three decibels a $(5/4)^3$ = a 2-fold increase, . . . 10 decibels a $(5/4)^{10}$ = a 10-fold increase, that is, a bel. More generally, two similar sounds of intensities I and I_0 and corresponding acoustical pressures p and p_0 are said to differ in intensity by n decibels when

$$n = 10 \log_{10} (I/I_0)$$
$$\text{or } n = 20 \log_{10} (p/p_0)$$

If I_0 or p_0 corresponds to some selected zero, then n becomes the number of decibels above that zero level.

Thus provided with an acoustical intensity scale, we can proceed to set up a loudness scale which is based on the accepted ability of the average individual to compare and match loudness. To this end (just as in photometry we make use of a standard candle) we need a standard sound; and for the purpose a pure reference tone is chosen which, on the British Standard Scale, has a frequency of 1000 cycles per second. We also require a zero of loudness at or near the threshold of hearing, and this is arbitrarily adopted as corresponding to a pressure of 0·0002 dyne per sq. cm. If now we operate the reference tone by successively increasing decibel steps of energy, the associated changes of loudness are expressed in numerically identical steps on a scale of *phons*. That is, if the reference tone is excited by an intensity of n decibels above the zero, the loudness is n phons. The equivalent loudness of any other sound or noise is evaluated by matching it by ear under specified conditions against the suitably adjusted reference tone, the numerical value of the latter in phons then giving the equivalent loudness of the sound to be measured. Thus by this procedure we have set up a subjective scale of equivalent loudness, the unit being the phon.

It happens that a phon corresponds roughly to the smallest difference of loudness which can be detected by alternate listening, in the case of a sound of medium frequency and moderate loudness. Experience shows, too, that for many loud noises of common occurrence the loudness level in phons is approximately equal to the intensity level in decibels—a convenient relation for many purposes.

A number of different zeros of loudness have unfortunately been employed in the past; for example, 1 millidyne per sq. cm., which results in numerical values of loudness some 14 phons less than with the British Standard zero. In Germany the phon is based on a zero of 0·0003 dyne per sq. cm., which is equivalent to a 4 db. difference from the B.S. zero. As, however, a different method of listening is employed, the slight discrepancy between the two scales is not known exactly. The American scale agrees with the British, except that in the United States it is customary to use the decibel not only for expressing intensity measurements, but also for loudness levels, it being implied in the latter case that the decibel figure quoted refers to the energy level (above the arbitrary zero) of the standard tone when it matches the sound to be measured. As already mentioned, the British Standards Institution recommends that for greater clarity the decibel should be restricted to energy ratios; and in its definition of the phon, the Institution kept open the way for eventual international agreement on the unit of equivalent loudness.

Happily such agreement came about at an international conference held in Paris last July, when it was unanimously agreed that the decibel and the phon should be adopted respectively as international units of intensity level and equivalent loudness, full agreement being secured on questions of the reference tone (1000 cycles per second), the reference zero (0·0002 dyne per sq. cm.) and the technique of listening. All these matters are in accord with the definitions in the acoustical glossary of the British Standards Institution.

NOISE METERS

Subjective noise meters.—Subjective noise meters depend on the equality matching of the loudness of a noise, as heard by the ear, with a reference tone (usually a pure tone of specified frequency and of graduated intensity) as heard in a telephone earpiece held tightly against one ear. The reference tone may be produced by an electric buzzer, valve oscillator or other means, various frequencies (for example, 1000 or 800 cycles per sec.) or mixed tones being used in commercial instruments. The usual Barkhausen technique involves simultaneous listening to the noise and the reference tone, but experience indicates that inconsistencies which are found to arise in aural measurements under such conditions are largely resolved when the two sounds are heard alternately for periods of not less than a second. Such a technique has been facilitated by Churcher in a subjective meter employing two earpieces, so that either the noise or the reference tone can be heard in turn using both ears simultaneously.

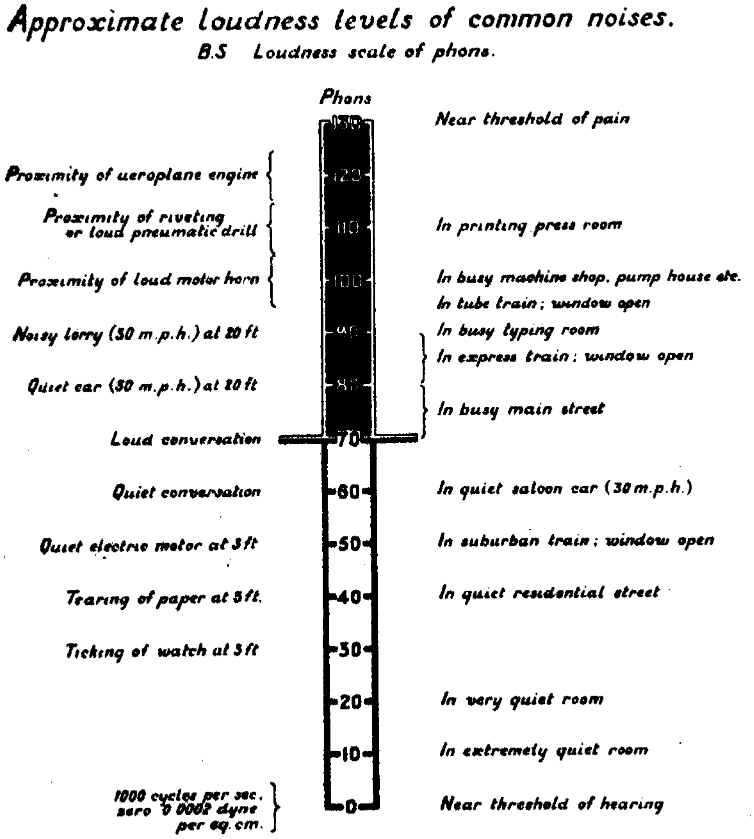

Fig. 1.

Subjective meters are useful for certain purposes, but the aural judging of equality of loudness of the reference tone and of a noise very different in character is not always easy. Observers are found to differ widely in their judgments, and the same individual is not always consistent. The accuracy of appraisement of a single observer is normally low (say 5 phons), and a team of trained observers is essential for higher precision (say 2 phons). In the case of unexpected or single impulsive sounds, the aural assessment presents great difficulties to the average observer.

Objective noise meters.—The problem of the designing of objective sound and noise meters, which has received much attention both in Great Britain and abroad, is of considerable complexity. The ideal aimed at by objective meters is to be able to measure every type of sound and noise on the subjective scale of phons, that is, to simulate the selectiveness and response of the average ear in all circumstances.

The various objective meters on the market all consist essentially of a pressure microphone connected to an amplifier provided with calibrated control, followed by some type of rectifier and an output indicator. As a first essential, objective meters are constructed to give the same reading for a range of steady pure tones which sound equally loud to the ear whatever the frequency. This is achieved by introducing into the amplifier electrical networks designed to modify the shape of the frequency characteristic so that it imitates the ear sensitivity at selected loudness levels. If the network is omitted, the meter measures intensity levels. Objective meters should be further designed to simulate the salient characteristics of the ear in dealing with either steady or impulsive sounds. For example, the ear does not record full strength until a steady sound has persisted for about one-fifth of a second, and in the case of pulsating sounds, the inertia of the instrument has to be of the right order to give readings corresponding to average aural appraisement.

There can be little doubt that the future of sound or noise measurement, from a practical point of view, lies with the objective meter. Even in its present state of development, its practical convenience often outweighs its limitations. It is free from personal bias, rapid in action and direct reading, and can be put into the hands of an untrained observer. Furthermore, as a dial instrument, it is well adapted to the enforcement of regulations or specifications.

NOISE-LEVEL MEASUREMENTS

In connexion with problems of noise abatement, the National Physical Laboratory has made measurements and analyses of many noises of very varied origin. The positions which some of these noises occupy in a scale of phons are shown in Fig. 1, the upper half of which includes various noises the abatement of which would be acceptable in many circumstances. This is illustrated by the homely test which most of us apply as a test of background of noise, namely, the ease with which conversation is possible. At 60 phons, conversation is 'comfortable'; at 90 phons, difficult; and at 110 phons, virtually impossible.

Among the noise problems on which the Laboratory has been consulted in recent years, are the mitigation of the noises associated with aeroplane cabins and engine-testing factories, trains, ships, tube railways, buses, motor horns, pneumatic drills, printing works, transformer substations, cathedrals, assembly halls, business offices, flats, miniature rifle ranges, building operations, and so on. Assistance is also being given in connection with the Home Office experiments on air-raid warnings.

The loudness of a noise depends, of course, on its remoteness and to a less degree on its environment. The inverse square law appears to be followed fairly exactly in the open for average sounds such as those of motor vehicles. In a room or a tunnel, the law does not hold and a noise sounds louder than it would outside, owing to the building up of the sound level by multiple reflection. Similar conditions prevail in a narrow busy street and contribute to the noise discomfort of the occupants in the upper stories, though to a pedestrian the noise of, say, a passing car is but little louder than in an open space. Incidentally, drivers of cars are familiar with the sudden access of high-pitched components from the engines, exhausts or tyres of their cars as they pass reflecting walls or fencing or even minor way-side objects such as tree trunks or telegraph poles.

One has also to remember that the path of a sound may appreciably modify its composition. For example, the high-frequency components may be abnormally reflected or absorbed as compared with lower notes which tend to pass through or round obstacles. Even in the open, a hedgerow or a barrage of trees may, to a limited extent, so serve as a muffler of traffic noise. The high-pitched components of a sound may further be selectively enfeebled in passing over different types of ground, for which the sound absorption may be three or four times as much for high notes as for low. To judge by experience, the absorption figures for newly fallen snow must be rather high, though I am not aware that they have been measured. High-frequency components may also be selectively absorbed by the air itself if it is humid. Knudsen has shown that the effect is due to interaction between the oxygen and water molecules, the nitrogen playing no part. Incidentally, he estimates that if we lived in an atmosphere of oxygen at a humidity of about 20 per cent, the high notes of the violin and piccolo would be completely inaudible 50 yards away.

(To be continued.)

The Sex Ratio*

By Prof F. A. E. Crew

THE subject of the numerical proportions of the sexes in a population necessarily appeals to so many interests that it is not surprising to find that considerable attention has been paid to it. But so complicated are the problems that cluster around it that even yet our understanding of the significance of the sex ratio is still very incomplete. Recent developments in cyto-genetics have removed many of the difficulties that have surrounded this subject, so that it is possible now to re-examine the problem more hopefully.

The Registrar-General's Report for 1935 shows that the secondary sex ratio was 105 : 100; that the sex ratio among those babies who died during the 7th–9th months of intra-uterine life was 110 : 100; that there is a remarkable swing in the sex ratio, a numerical preponderance of males amongst the earlier age groups of the population giving place to a numerical equality of the sexes amongst the 15–19 year olds, whilst amongst the 20–24 year olds the females actually begin to outnumber the males; and thereafter, as age group succeeds age group, this female numerical ascendancy progressively increases until, among the 85's and over, there are more than twice as many women as men.

This swing in the sex ratio from high to very low is shown to be the result of a sexually selective mortality, for the mortality tables make it clear that at all ages relatively more males are removed from the population by death.

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* From the presidential address for Section D (Zoology) of the British Association, delivered at Nottingham on September 2.

A consideration of these and similar facts ultimately leads to the conclusion that in the case of man, for some reason or other, the male, in virtue of his maleness, is less viable than the female, and that, in unfavourable circumstances, both pre-natally and post-natally, the male, because of this greater inherent fragility, suffers more easily and more severely than does the female, and is removed from the population by death in greater numbers. Furthermore, since this selective elimination of the male occurs before, as well as after, birth, it follows that the primary sex ratio is probably considerably higher than the secondary sex ratio.

A comparison of the secondary sex ratio in different countries, in town and country, as affected by migration, amongst legitimates and illegitimates, amongst whites and coloured, living under the same conditions, in different social strata, and in its relation to infantile mortality would seem to show that the whole course of sex mortality in pre-natal life, in infancy, and in all subsequent age periods is consistent with the view that the male in man is the inherently weaker sex, more prone on account of his relative constitutional weakness to developmental anomalies, to congenital debility and to death from diseases of all kinds.

Male must be contrasted with female in an attempt to discover the cause of this, and a study of the sex ratio in other mammals, birds and insects, wild and domesticated, both in the open and under the controlled conditions of experimentation, must be made, for, in this matter of the sex ratio, to know only man is to understand nothing.

Male differs from female in genetic constitution. In the case of man the male is the heterogametic sex. This being so, it follows that in the homogametic female a mutant recessive gene in one X can be cancelled out by its wild-type dominant allele in the other, whereas the same recessive gene in the single X of the heterogametic individual is unchecked and unrestrained and is expressed to produce its full effect. Upon this firm basis of ascertained fact, the sex-linked lethal theory, which seeks to account for the sexually selective mortality and the swing in the sex ratio, has been built.

It is clear that genetic lethals exist in considerable numbers in all animal and plant stocks that have been subjected to genetical experimentation. They are genes which can be mapped and which have an effect upon the secondary sex ratio that can be predicted. But since differences in chromosome constitution may imply more than a difference in respect of sex-linked lethals, they may also mean a difference in genic balance. It may be that this difference is itself the cause of unequal mortality, though it is difficult to regard the male as being less well-balanced genically since he has endured as long a course of selection as has the female, and it would be expected that dosage compensation would ensure a proper balance in each sex regardless of dosage ratios.

There are other genetic differences between the sexes which are sex-limited and not sex-linked. It is established that many defects and derangements in man, formerly regarded as recessives, are partial irregular dominants, and that many of these are more often and more completely expressed in the male than in the female. Many characters previously regarded as sex-linked are now known to be sex-limited, being expressed only in the male.

There are other differences, metabolic and physiological, which quickly appear in development and which give rise to endocrinological differences which, when once established, take charge of the further differentiation and the maintenance of sexuality in the higher forms. The initial genetic constitution would seem to determine which of two alternative types of differentiation shall occur and, with the incoming of the gonad and the rest of the endocrine system, maleness or else femaleness becomes finally and firmly established. These two states are to be distinguished by sustained differences in oxidation rate. Experiment has shown that the higher metabolic rate of the male renders him less resistant to unfavourable conditions and more prone to death.

A survey of what is known of the sex ratio amongst livestock and laboratory animals shows that, in general, the male amongst them shares with the male of man a relative frailty and endures a selective elimination both before and after birth.

The figures for birds are somewhat confusing. As a whole, they seem to show that it is the heterogametic sex (the female in birds) upon which death falls more heavily pre-natally. If this is so, it can at once be decided that in the heterogametic mechanism itself a factor of importance is to be found.

As a general rule, the males of all groups, except those derived from wide crosses in which genic balance is more likely to be unusual, appear to show a relatively low viability, irrespective of their homo- or heterogamety, and the difference in the death rates of the sexes appears to be as much correlated with sexuality itself as with any particular type of chromosome or gene equipment. That this should be so is perhaps not surprising when the relative reproductive values of the sexes are compared. The major task of one generation of gamete producers is the production, economically and efficiently, of a succeeding generation that numerically will be in harmony with the conditions and resources of the habitat. That of the females of a generation is the production of the requisite number of ova; that of the males the production of spermatozoa in numbers sufficient to make the fertilization of every available egg highly probable. The number of spermatozoa required will be determined by many factors—for example, the variety of the fertilization process, the pre-natal and post-natal relations of mother and offspring, the relationship of male to female in respect of parentage. If the male is merely a fertilizing agent, then economy and efficiency are observed if the male dies *in coitu* or is for other reasons shorter-lived than the female, so long as there are more or less equal numbers of males and females of the age when fertilization occurs. If the male is concerned with the protection of and food-finding for the female and her young, then the length of life of the male might be expected to be related to the duration of the period of dependency of the young upon the parents and of the female upon the male, and it might reasonably be assumed that when the male has served his purpose he would be removed so that savings in food energy could be effected and used for further reproduction.

Reference has already been made to the fact that in the Registrar-General's Report for 1935 the sex ratio most nearly approached equality amongst those in the population aged 15–19 years. In the Report on the Census of Scotland, 1931, table 31, vol. 2, it is seen that in this human population, though between the ages of 0–14 there were more males than females and between the ages of 20–100 there were more females than males, the sex ratio of those in the population between the ages of 15 and 19 years was equality. It can be stated, therefore, that in the case of these human populations, the sex ratio is equality only amongst those who stand at the threshold of their reproductive prime. This fact is surely not without significance. The age group in which the sex ratio is equality consists of those who, biologically if not socially, are newly equipped for ardent reproduction. Amongst them there is no surplus: there are equal numbers of males and females. If, during the biological evolution of man, pair-mating attached to itself a definite and positive value, it would be expected that all the mechanisms concerned in the establishment of a sex ratio of near equality among the 14–19 age group would, through selection, come ultimately to be related harmoniously to this end.

Implied in this suggestion is yet another: that in the case of any population of living things and under the conditions that exist in any given place and at any given time, there is an optimum sex ratio amongst those of the ages associated with the fullest expression of the reproductive function, and that through selection all the mechanisms, whatever they may be, which influence this are fashioned into harmony with this 'reproductive' sex ratio. It is necessary, therefore, to discuss the meaning in biological philosophy of mutation, sex and heterogamety, all of which are intimately concerned.

Mutation is a mechanism that has become adapted and elaborated for the provision of material possibilities of evolutionary movement. It takes the form of the replacement of one gene by an allelomorph—the substitution of a gene that, having been tested and found worthy, has come to be in harmony with the rest of the genotype, and through this with the conditions of the external environment, by another, the merits of which have yet to be determined. More often than not, therefore, mutation implies a disturbance of an equilibrium within the genotype itself, and between this and the external environment. It is usual, therefore, to find that mutation leaves the genotype less in harmony with the existing external conditions than was that which it has replaced. Mutation, the inception of a new heritable variation, thus usually equips its possessors with a handicap, imposing on them a disadvantage that can range from inconvenience to complete lethality.

Sex is the mechanism that has become adapted for the dispersal of a mutant gene amongst a population. Through its exercise a new gene can become incorporated into a variety of genotypes, and thus given the opportunity of finding itself associated with other genes with which it can interact. It is established that the quality of the action of a gene is largely determined by this interaction with others, for, as judged by its effects upon the life processes of the zygote, it can exhibit disadvantageous properties when in one gene association, advantageous when in another. For the quiet dispersal of a mutant gene in this way it is necessary that it should be recessive, initially at least, to the gene that it has displaced, for then it can pursue a cryptomeric existence for a considerable period of time.

If the great usefulness of sexuality lies in the opportunities it provides for variety in gene recombination and for the exercise of selection, then its advantages will be best exploited when, among those about to reproduce, there is a sex ratio of equality. This observation would not seem to apply to those instances in which gene combinations that are common or are exceedingly rare are concerned, but a sex ratio of equality among the parents would seem to provide the greatest variety of recombinations in the offspring in the case of gene combination of intermediate rarity. Be this as it may, a device for the production of a sex ratio of equality has certainly been elaborated.

Heterogamety is a mechanism that has become adapted for the production of a primary sex ratio of equality. In its evolution in the higher forms it has taken the form of the replacement in one sex of an X-chromosome by a wholly or largely non-homologous Y-chromosome. The heterogametic sex, therefore, now possesses one X-chromosome, the homogametic, two. An indirect result of this evolution has been that a recessive mutant gene in the differential segment of the X-chromosome is at once uncovered in the case of the heterogametic individual, and so, if in its action such a gene is disadvantageous, deleterious or lethal, to it no time is allowed for the finding of modifying company and for the pursuit of its own evolutionary development. It is expressed and tested within a very short time of its first appearance, and should it cripple or kill, it is the heterogametic sex that is affected. In this way the sex ratio becomes modified, for the heterogametics either die before birth or else their early post-natal mortality is greater than is that of the homogametics. It is somewhat surprising that so few sex-linked lethals have so far been discovered in mammals. It would seem that the differential segment of the X is relatively insignificant and that the cross-over portion, which could not yield a differential mortality since its genes would not automatically be expressed in the male, is relatively large.

It is thus possible to look upon the inequality in capacity for continued life between the sexes as being partly of the nature of an evolutionary oversight due to a lag in the development of a harmonious relationship between the mechanisms of mutation and heterogamety. But this disharmony has been repaired by the invention of a supplementary device which can provide a compensatory primary sex ratio, high in those species with male heterogamety, low in those in which the heterogametic sex is the female. It is established that in many, though not in all, mammalian stocks, the primary sex ratio is much higher than is the secondary, and it is in such stocks that there is much sexually selective mortality operating to the disadvantage of the heterogametic sex. This being so, it seems reasonable to entertain the view that these three variables—the primary sex ratio, a sexually selective pre-natal and early post-natal mortality and the optimum reproductive sex ratio—are somehow related, the dimensions of the first being connected with the amount of the second. Should this prove to be the case, then it would follow that in general the greater the incidence of mutation, the more common the sex-linked recessive lethals and the greater the difference in the sex incidence of mortality in adolescence in a stock with male heterogamety, the higher will be the primary sex ratio; and, conversely, the rarer mutation is, the fewer the lethals and the less the difference in the sex incidence of mortality between conception and reproductive prime, the nearer to equality will this primary sex ratio be.

This suggestion, of course, demands that there should be genes which affect the functioning of the heterogametic mechanism, and also that it should be possible, by continued selection, to modify the primary sex ratio of a stock. This will be equality when the heterogametic sex elaborates its two kinds of gametes, X- and Y-chromosome-bearing respectively, in equal numbers, and when both of these are equally functional in fertilization. Conversely, the primary sex ratio will be removed more or less from equality if and when the two forms of gametes are not produced by the heterogametic sex in equal numbers, or when, between these two forms, there is functional inequality. The fact that in those instances where the primary sex ratio is not equality it is the Y-bearing gamete that is either produced in greater numbers or is greatly advantaged in fertilization, so that more XY than XX gametes are produced, is of great interest in view of the observed fact that it is the XY zygote that suffers more through the action of sex-linked lethals.

It has been shown to be possible, by continued selection within an animal stock, to produce high and low sex ratio strains, and thus it would appear that there are genes which can be concentrated in a genotype which, in their action, influence the heterogametic mechanism affecting either the relative production of the two kinds of gametes produced by the heterogametic sex or else their relative functional ability. If, as seems to be the case, the male in many forms and irrespective of his chromosome constitution is the weaker sex, then in those instances in which the male is homogametic an excess of X-chromosome-bearing ova is demanded from the heterogametic females or else there must be some form of selective fertilization, the X-ova being more often or more readily fertilized.

That genes which lead to the production of X- and Y-bearing gametes in unequal numbers do exist is shown very clearly indeed by the work of Sturtevant and others. One such gene was discovered as long ago as 1922 (Morgan, Bridges and Sturtevant, 1925) in a strain of *Drosophila affinis* in which occasional males were found to produce families consisting almost entirely of females. A definite *X*-borne gene was suspected. Gershenson (1928) found a similar gene in *Drosophila obscura*, and showed that it was indeed resident in the *X*-chromosome. A male carrying this gene produces very few sons, regardless of the genetic nature of his mate. More recently (1936) Sturtevant and Dobzhansky have found that this gene has a very wide geographical distribution in both races of *Drosophila pseudo-obscura*, that it is sex-linked, lying in the right arm of the *X*-chromosome, and being associated with a small inversion. Cytological study has shown that in these cases the *X*-chromosome undergoes equatorial division at each meiotic division, whilst the *Y*-chromosome degenerates, with the result that a male carrying this gene produces nearly all *X*-sperm instead of the usual 50 per cent. It is to be expected, of course, that a sex ratio gene of this kind would be discovered only if its effects upon the sex ratio were profound. But the existence of such genes permits us to assume that other genes of the same kind, having less severe effects upon the heterogametic mechanism, also exist and are responsible for minor distortions of the sex ratio. If such genes do exist, then, of course, they can be incorporated into, or extruded from a genotype, and upon them selective agencies can work their will. These sex ratio genes may perhaps provide a partial explanation of the observation that hybridization commonly is attended by marked distortions of the secondary sex ratio.

But all this is so much speculation, and the only justification for toying with such ideas is that criticism may be aroused and experimentation launched. I have presented evidence to show that three possible causes of sex differences in mortality have to be considered: (1) sex-linked lethals, (2) sex-limitation of defects and derangements, and (3) sex-dimorphic physiological and endocrinological differences. It seems probable that sex-linked lethals play only a minor part and that the defects and derangements that have come to be manifested only or more completely in the male owing to his relative unimportance in respect of propagation, constitute the major cause, though as yet too little is known of sex differences in respect of hormones and their effects to permit us to regard these as unimportant.

The British Association at Nottingham

THE British Association opened at Nottingham on Wednesday, September 1, at a time when local residents feared that a pleasant spell of very fine weather was to be rudely broken; but after a severe storm had passed over, the Association settled down to enjoy days of bright sunshine. The attendance of more than two thousand members is regarded as quite satisfactory, and there is no doubt that those visiting the city for the first time were definitely impressed by the delightful setting of the University College and the accommodation it provided. The opening presidential address on the history of evolutionary thought was well supported, and Prof. W. W. Watts, in moving a vote of thanks, suggested that the fact that Sir Edward Poulton had a son who was president of a Section provided a proof of natural selection.

The presidential addresses to the Sections were crowded. Mr. H. G. Wells had some striking things to say about education, but, so far as one could judge, they served only to increase the admiration and adulation of the professional members in his audience. His contentions were, in a way, supported by Prof. E. J. Salisbury's address to Section K (Botany), which one member described as "short, simple and lovable". They were also supported by speakers at a later discussion on the educational function of a university. Prof. F. A. E. Crew's presidential address was regarded as one of the most stimulating of the whole meeting. It was, however, in Section A that records were broken in an extraordinary manner by Dr. G. W. C. Kaye. Here, for the first time, a president took acoustics as the subject of his address, and delivered it, appropriately enough, in a lecture theatre designed by Prof. E. H. Barton just before his death. Moreover, the address was for the first time illustrated by experiments, in which a selection of some forty motor-horns were used with great effect to produce another record in noise. Perhaps it was the general appeal of the subject which caused Section A to be crowded out and to provide a further record in the nature of a repeat performance of the experiments later in the day. Section A must also be credited with another record, which it certainly did not seek; one of its most pleasant social activities appeared in the programme under the heading "mystery trip".

The general discussions had clearly been well planned. Dr. F. L. Pyman's presidential address to Section B opened a stimulating symposium on various aspects of chemotherapy, while, at the same time, local geologists, headed by Prof. H. H. Swinnerton, had the pleasure of describing the geology of the Nottingham district to Section C.

Section A enjoyed a general discussion on the mode of action of the photographic plate, in which a theory of latent image formation put forward by Prof. N. F. Mott was closely followed. Sections A, B and I gathered to hear a useful symposium on surface action in biology initiated by Dr. Irving Langmuir. Prof. D. Brunt added much interest to a discussion of the upper atmosphere by releasing a sounding balloon, carrying a Dines meteograph to record the pressure and temperature at different stages of its ascent, and a ten-shilling note with an I.O.U. for a like sum to ensure its return. The balloon was released in the College grounds on Monday morning in the presence of an enthusiastic crowd. Less spectacular, but of considerable interest to local members, was the joint discussions of Sections C and E on the potential mineral resources of Nottinghamshire and Lincolnshire and their geographical significance. Perhaps the star turn in the joint discussions was the meeting of Sections C, D, E, F, K and M on Tuesday evening to talk about planning the land of Britain.

There can be no doubt that from a scientific point of view the Nottingham meeting was an unqualified success. From a social point of view it was equally pleasant. The excellent hostel accommodation, situated so close to the College and in the same beautiful surroundings, contributed greatly to the happiness of visiting members. The civic reception was obviously thoroughly enjoyed by guests and hosts alike, the flood-lit gardens of the Castle being much admired. Works visits, garden parties and excursions were heavily booked. Local firms and industrial undertakings were most generous in entertaining the Association. At the same time, the extraordinarily fine series of cinema films on subjects of biological interest, shown to members in the Savoy Cinema, proved to be a great attraction.

Forty-four years is the interval of time between the last two visits of the Association to Nottingham ; it is to be hoped that, both on scientific and social grounds, the Association will not wait another forty years before it returns.

On September 3 the General Committee adopted the nomination of the Council of Lord Rayleigh to succeed Sir Edward Poulton as president of the Association. The General Officers will continue to be Prof. P. G. H. Boswell as General Treasurer and Prof. F. T. Brooks and Prof. Allan Ferguson as General Secretaries. The new members of Council are Prof. T. S. Moore, Mr. R. S. Whipple, Prof. H. J. Fleure, Prof. J. G. Smith and Prof. J. C. Philip.

Future places of meeting of the Association are Cambridge (Aug. 17–24, 1938) and Dundee (1939). Invitations have been received for the Association to meet in Swansea in any convenient year, in Belfast in 1941 or any year nearly following, and in 1943 in Birmingham.

Under the arrangement proposed last year by the Council and adopted by the General Committee, the British Science Guild was incorporated into the Association as from November 30, 1936. In accordance with the agreement of incorporation a British Science Guild Committee has been appointed to continue arrangements for lectures already initiated by the Guild, and for any others of similar character which may be approved by the Council. The first of the lectures arranged by the Association under the above scheme was the Alexander Pedler lecture, given in Leicester on May 3, in co-operation with the University College in that city, by Prof. Allan Ferguson. The first Norman Lockyer lecture to be so arranged will be given by Dr. R. E. Mortimer Wheeler in the Goldsmiths' Hall, London, by kind permission of the Goldsmiths' Company, on November 24.

The first of the triennial lectures under the foundation of Mr. G. Radford Mather will be given by the Rt. Hon. J. Ramsay Macdonald, M.P., F.R.S., in the Royal Institution, London, by kind permission of the managers, on October 22.

The Council records with much satisfaction that Lord Rutherford has accepted the presidency of the joint Congress of the Indian Science Congress Association and a delegation from the British Association in January next.

Obituary Notice

Prof. F. C. S. Schiller

PROF. F. C. S. SCHILLER, who died in Los Angeles on August 7 after a long and lingering illness, was born in 1864, the son of Ferdinand Schiller of Calcutta. He was educated at Rugby and Balliol, and graduated in the first class of Literæ Humaniores, winning later the Taylorian scholarship for German in 1887. For a few years (1893–97) he occupied the post of instructor in philosophy at Cornell University. Then in 1897 he returned to Oxford, and became fellow and tutor of Corpus, where he remained for more than thirty years. His former pupils speak of him as a decidedly stimulating and suggestive teacher, who, although out of touch with the types of philosophical theory prevalent in Oxford, exerted considerable influence there as an acute critic and searcher after truth. He was president of the Aristotelian Society in 1921, and had from 1906 onwards contributed to its *Proceedings* a large number of papers. At philosophical gatherings he was a well-known figure; he read, for example, a paper at the International Congress of Philosophy, held at Harvard in 1926. To *Mind* he was a frequent contributor, and was for many years treasurer of the *Mind* Association. In 1926 he was elected a fellow of the British Academy. In 1929 he was appointed visiting professor in the University of Southern California, and was accustomed latterly to spend half of each year in the United States and half in England.

Schiller's student life in Oxford began immediately after the death of T. H. Green, but from the outset he was out of sympathy with Green's idealism. In his earliest book, "Riddles of the Sphinx", published under the pseudonym "A Troglodyte" in 1901 (2nd edition, revised, with the author's own name, in 1904, new edition 1910), Schiller followed largely in the line of the evolution theory, as expounded by Darwin; and developed at some length a view, not unlike that of J. S. Mill, of God as a finite individual, immanent in the world as a living activity, but transcendent as a true personality. In the following year, in 1902, the volume entitled "Personal Idealism" appeared, containing contributions from eight members of the University of Oxford; Schiller's essay therein was on "Axioms as Postulates", and in this essay he outlined for the first time the position which, following William James, he designated as that of 'pragmatism', or later 'humanism'.

Truth, Schiller maintained, is *human truth*, and is incapable of coming into being without human effort and agency. Human action is psychologically conditioned; consequently, the concrete fullness of human interests, desires, emotions, satisfactions, purposes, hopes and fears is relevant to a theory of knowledge and must not be abstracted from. The world of our experience is not a ready-made datum; it is essentially what we make of it. Fruitless, therefore, is it to attempt to define it by what it was originally or by what it would be apart from us; it *is* what is made of it. Accordingly, the world is *plastic* and may be moulded by our wishes, if only we are determined to give effect to them, and are content to learn from experience, that is, by trying *by what means* we may do so. The principles we employ in such construction are, it was urged, in the beginning *demands* we make upon our experience, postulates or hypotheses, "starting-points and stepping-stones". Of these, when tried, many have to be abandoned; others remain precarious, and more or less 'matters of faith'; only a few rise to be unquestioned axioms. The "making of truth" is thus, it was contended, in a very real sense also a "making of reality". For in validating our claims to 'truth' we really 'discover' realities; and we virtually *transform* these by our cognitive efforts, thereby proving our desires and ideas to be real forces in the shaping of our world.

Perhaps Schiller's chief contribution to the thought of his time is to be found in his sustained insistence on the way in which principles, even those which appear to be the most self-evident and fundamental, are in point of fact tentative, and require to be tested by their success or want of success in enabling the investigator to get into touch with natural events; and in the repeated emphasis which he laid on the manner in which apparent facts receive modification through the growth of science. Furthermore, that man is not to be separated from Nature, and looked upon as a mere observer of a series of events which he can do nothing to alter, that revaluation and not static finality is a main feature of any truth discoverable by man—these are certainly points which it was worth while to emphasize, and upon them Schiller was constantly laying stress.

In addition to the works already referred to, Schiller was the author of "Humanism", 1903 (2nd edition 1912), "Studies in Humanism", 1907 (2nd edition 1912) and "Plato or Protagoras", 1908. He wrote also two books on logic—one, "Formal Logic: A Scientific and Social Problem", 1912, which was a sustained attack on what he regarded as the futility, the verbalism, the self-contradictoriness of the traditional logic; the other, which was a more constructive work, "Logic for Use", 1929. In the latter the logic which he desiderated was not the logic of proof but the logic of discovery, and he has said probably wellnigh everything there is to say on this subject. Nor must one omit to mention the two contributions he made to Singer's "Studies in the History and Methods of Science", on "Scientific Discovery and Logical Proof" in vol. 1 (1917) and on "Hypothesis" in vol. 2 (1921). G. D. H.

WE regret to announce the following deaths:

Prof. Hendrik Aldersloff, director of the State Serum Institute at Utrecht, president of the Dutch Society for the Advancement of Medicine, editor of the *Tijdschrift voor Sociale Hygiëne*, aged sixty years.

Prof. P. W. Cloassen, professor of biology in Cornell University, known for his work in economic entomology, on August 16, aged fifty-one years.

Prof. J. E. Duerden, who was associated with the Wool Industries Research Association, Torridon, Headingley, Leeds, and formerly professor of zoology in the Rhodes University College, Grahamstown, on September 4, aged seventy-two years.

Prof. Albert Heim, For. Mem. R.S., formerly director of the Geological Museum and Swiss Geological Survey, Zurich, on September 1, aged eighty-nine years.

Prof. M. Maclean, emeritus professor of electrical engineering in the Royal Technical College, Glasgow, on September 2.

Prof. Pietro R. Pirotta, formerly professor of botany in the University of Rome, on August 4, aged eighty-three years.

Mr. F. C. Thompson, lecturer in the Department of Leather Industries in the University of Leeds, aged forty-six years.

News and Views

The Right Hon. Lord Rayleigh, F.R.S.

THE British Association holds its annual meeting in Cambridge in August 1938, and the General Committee of the Association has elected Lord Rayleigh to the presidential chair for that meeting in succession to the veteran biologist Sir Edward Poulton. Readers of NATURE need little introduction to Lord Rayleigh, whose influence on the development of physical science has been so patent and so profound. First and foremost an experimental physicist, he has his father's flair for recognizing those aspects of an experimental investigation which most need stressing, and for extracting results of fundamental importance from apparatus of simple, even primitive, type. His work on radium and the earth's heat is classic in quality, and he has elucidated many diverse, and yet related, phenomena in his studies of the aurora borealis, the light of the night sky, the green flash, and the fluorescence of mercury vapour. He has lately studied the conditions of optical contact of glass surfaces, and has investigated, by admirably simple methods, the pull required to separate, and the work done in separating, contacted surfaces. He has measured the small amount of reflection between two contacted glass surfaces, and has shown that the blackness of the black centre of the Newton's rings formed between a spherical and a plane surface is by no means perfect.

LORD RAYLEIGH'S services to science on the administrative side are equally varied and weighty. He is chairman of the governors of the Imperial College of Science and Technology, and of the executive committee of the National Physical Laboratory. He had filled the offices of foreign secretary of the Royal Society, of president of Section A of the British Association, and of president of the Physical Society. Lord Rayleigh's contacts with Cambridge are many, and make the choice of the General Committee a singularly happy one. The nature and scope of his address remain to be seen, but, whatever be his choice, the scientific world, and indeed, the world at large, may look forward to receiving a pronouncement of fundamental importance.

Grass and the Nation's Food Supply

DR. R. E. SLADE'S evening discourse at the British Association, delivered on September 3, came well within the category of scientific contributions bearing upon social welfare, for it demonstrated the physical possibility of greatly increasing the nation's home-grown food supply, and incidentally of improving soil fertility and of helping to put the much-suffering farmer upon his financial feet. A conspicuous feature of recent agricultural progress has been the recognition of grass as a crop, and how by good management and the use of scientific methods of grass conservation, the productivity of pastures can be immensely increased. Early researches on grass as a food for stock were largely confined to hay, and though this form of 'bottled sunshine' is unlikely ever to disappear, the nutrients in grass can be best conserved either as ensilage or as artificially dried grass. No system of cultivating grassland can be adequate unless it takes cognizance of the reaction between the pasture herbage and the grazing animal, for by controlling the time and intensity of grazing or cutting, by judicious manuring, and by timely cultivations, a succession of palatable and nutritious herbage can be maintained throughout the grazing season, and this season can be extended at both ends, that is, in spring and in autumn. The re-discovery by Prof. T. B. Wood and Dr. H. E. Woodman of the high feeding value of leafy, young grass, and the breeding of leafy and highly nutritious strains of indigenous grasses by Prof. R. G. Stapledon and his co-workers at Aberystwyth, have opened up a vista of great possibilities for home agriculture and national food supply.

As an example of what can be done to improve the yield of food material from grassland, Dr. Slade described the results of a highly interesting experiment that has been carried on since 1935 at a large dairy farm near Middlewich, in Cheshire, where the climate is favourable and the management has been scientific as well as practical. Monthly records of milk production and live-weight increase of animals have been recorded throughout, and from these data the amounts of food (protein and starch equivalents) provided by the grass and the hay have been calculated. The average yield of crude protein per acre in 1935 and 1936 was 640 lb., which is three to four times as much as that given by an average pasture in Great Britain. Equally good results have been obtained on a 'farmer's farm' near Middlesbrough, in Yorkshire, over a period of ten years, and it was suggested that yields of crude protein up to 1,500 lb. per acre should be obtainable when Prof. Stapledon's new strains of indigenous grasses become available. A yield of 700 lb. protein per acre is equivalent to a yield of 45 lb. protein as dressed beef, or to 103 lb. protein as milk, which is just about the amount of protein provided for human food by an average acre of wheat. Pigs fed on grass protein could provide 70 lb. of pork per acre of grassland, but for this purpose the grass would have to be defibrinated. What is needed, and what seems feasible, is a protein-rich food made from grass deprived of its fibre, a kind of 'grass cheese', which could be fed to pigs for producing pork, and in times of national emergency could be eaten by the people.

Science and Progress

THE address, "Science in Everyday Life", given at Long Eaton on September 7 in connexion with the Nottingham meeting of the British Association by Dr. J. E. R. Constable, dealt with the more popular side of the activities of the Department of Scientific and Industrial Research and the laboratories engaged in research under its auspices. The National Physical Laboratory has, for example, fostered the use of X-rays for the detection of internal defects in steamship and aeroplane propellers, in almost all types of industrial products and in human teeth, and of foreign bodies in packed foods. It has also undertaken the measurement of noise and suggested methods of diminishing noises in buildings by the use of sound-absorbing devices. The Fuel Research Station has been investigating the best methods of getting the most heat and the least smoke from coal, while the Food Investigation Board has been finding out the best methods of keeping foods of all kinds in cold storage for long periods without its deteriorating.

ANOTHER branch of the activities of the Department to which Dr. Constable referred was that of the Road Research Laboratory, which is determining the best methods and materials for the construction of roads with good wearing qualities and non-skid surfaces. Machines for measuring the durability and non-skid property of sample roads and for determining when a road surface must be condemned as bad have been constructed and are giving valuable information. Closely associated with this laboratory is that for building research, which has succeeded in solving some of the difficulties in the production on a large scale of uniformity in structural materials such as concrete, and in the preservation of the stonework of buildings, and has investigated the best methods of dealing with many of the newer quick-setting plasters and cements. As a result of the work of the laboratory the smoking chimney need no longer be tolerated.

Dr. R. d'E. Atkinson

DR. R. D'E. ATKINSON has been appointed chief assistant in the Royal Observatory, Greenwich. Dr. Atkinson obtained a first class in the Physics Final Honour School in Oxford in 1922 and was elected to a research fellowship at Hertford College. In 1926 he obtained a Rockefeller travelling fellowship and studied in Göttingen for two years under Prof. Franck, taking the D.Phil. degree. After a short period as demonstrator in the physics laboratory of the Technische Hochschule in Berlin-Charlottenburg, he was appointed assistant professor and, in 1933, associate professor of physics in the Rutgers University, New Brunswick. Dr. Atkinson has published many papers. Of particular interest is his work on atomic synthesis and the source of stellar energy, in the course of which he deduced, before the discovery of the neutron, from general considerations of atomic abundance in the sun and stars, that there must be some type of particle that could penetrate a highly charged nucleus more easily than a proton.

Charles Bouchard (1837–1915)

CHARLES JACQUES BOUCHARD, a distinguished French physician, was born on September 6, 1837. He studied medicine first at Lyons and then in Paris, where he became house physician to Charcot, with whom he afterwards collaborated in the study of certain nervous diseases. He is best known for his works on the pathology of cerebral hæmorrhage (1866) and autointoxication (1887), both of which were translated into English, and the diseases caused by diminished nutrition (1870–80). He was also co-editor of a system of medicine with Charcot and Brissaud (1891–94) and of a treatise on general pathology in collaboration with H. Roger (1895–1903). In 1887 he founded the *Revue de la Tuberculose* with Verneuil, and in 1899 the *Journal de Physiologie et de Pathologie Générale* with Chauveau as his co-editor. Bouchard was one of the first physicians in Paris to take an interest in radiology, and installed a radioscopic apparatus at his own expense for the examination of his patients at the Charité hospital, where he was physician. In addition to occupying the chair of general pathology and therapeutics in the Paris faculty of medicine (1877) his distinctions included the presidency of the second French Congress of Medicine (1895), Société de Biologie (1896) and Academy of Sciences (1908). His death took place on October 28, 1915. The work entitled "Un Médecin Philosophe : Charles Bouchard, son œuvre et son temps", by Paul Legendre (1924), forms one of the outstanding medical biographies.

Trades Union Congress and Science

THE announcement made by Mr. Ernest Bevin in his presidential address to the Trades Union Congress meeting at Norwich of the formation of a scientific advisory council will be widely welcomed. Mr. Bevin paid tribute to the progress that science has made, but pointed out that society has not kept pace with it in making the fundamental readjustments and assimilating the results of research, discovery and invention. The General Council of the Congress believes that men of science can make a further contribution to progress by assisting such a movement as the Trades Union Congress with counsel and knowledge. It has accordingly decided to establish a Scientific Advisory Council, the purpose of which will be to enable the Congress and its constituent unions to secure the help and advice of leading scientific workers in some systematic and regular way. "The General Council are convinced that their prevision and foreknowledge of the significance of scientific discovery in all fields of research would be of incalculable value not only to the trade union movement, but to the community." Mr. Bevin gave a warning that this does not mean that scientific workers are to be invited to frame the policy of the Congress ; the General Council wishes to be in touch with representative men of science by means of such an advisory council and panels of scientific workers, from which it will be able to obtain information and advice in dealing with its own problems. It would clearly be to the advantage of both science and labour if the Congress were represented upon research boards and research associations concerned with industrial developments. The human factor in industrial progress has often been neglected in the past, and by bringing representatives of labour into close association with scientific and inventive work, the degrading results of some of their past applications to industry may be avoided.

Racial Doctrine

A NEW periodical publication with the title *Races et Racisme* is devoted to the record of current development in the application of theories of race to the doctrine of nationalism, with special reference to Germany (office of publication, 47 rue de Miromesnil, Paris VIIIe, price 1 fr.). Its main object is to keep the French people abreast of the progress of a movement of supreme importance in the world of to-day, upon which, it is thought, they are not sufficiently well informed. It should also prove valuable to those who desire first-hand and trustworthy information in readily accessible form of the increasing restrictions and penalties which are being imposed on freedom of thought and scientific and intellectual development in the nationalist-socialistic State. The utility of such a publication must clearly depend upon its freedom from the taint of the selective activity of the propagandist. The names which appear on the lists of the Comité de Patronage and the Comité Directeur are a guarantee that an objective impartiality will be exercised in the selection of material for publication. The lists include such well-known names as M. Gabriel Hanotaux, Prof. Lucien Lévy-Bruhl, Prof. Paul Pelliot, Prof. G. Bouglé, P. Maurice Leenardt, le Comte Jean de Pange, and Prof. Paul Rivet, with Prof. E. Vermeil as one of two secretaries. *Races et Racisme*, of which numbers will appear at two-monthly intervals, will represent the trend of German thought in racial doctrine by verbatim reports, or full abstracts, of official documents, new laws and regulations, official pronouncements, articles and speeches of authority, as well as by analyses of books and a record of relevant events—all, as a rule, without comment, except when further explanation is considered necessary.

AN example of the commentary which the editorial body considers appropriate is afforded by the opening article, which runs through the two numbers before us and is still in progress. This is an exposition of the development of racial ideas in Germany by M. Edmond Vermeil. It begins with Leibniz and Herder and the concepts of the eighteenth century, and shows how the Germanic idea has progressed from the universalism of the philosopher to the Pan-Germanism upon which the doctrine of 'race' and 'blood' has been engrafted to implement Hitlerian nationalism. M. Vermeil, who takes a broad and philosophic view of his subject, will, in his later instalments, demonstrate how and why what appears to be no more than a political manœuvre, when judged by its objective, must necessarily permeate and transform activities, apparently remote from the political arena when functioning freely, to produce 'German' art, a 'German' science and a 'German' religion. It is to be noted, however, that the sweeping official claims for purity of race and the coincidence of Nordic and Aryan are so far abandoned that Prof. Oswald Kron of Tübingen is permitted to say that there are five or six races among the German people, while he claims for them a psychological unity.

Native Lands in South Africa: A "New Deal"

CONSIDERABLE progress has been made in the provision of additional reserves for the native population of South Africa since the passing of the Native Lands Act, which was promulgated in August, 1936. Up to July last, according to a dispatch from the Cape Town correspondent of *The Times*, which appears in the issue of September 3, £800,000 has already been spent on the purchase of farms from Europeans. The farms which have been bought up to the present are mostly situated in the Transvaal, where the need for native land is greatest, as this is the principal area of native location on European farms, a practice which will not be permitted in future. The land is being allotted to the natives and settlement will proceed as the present European holders vacate. They have been permitted to remain in possession until after their harvest, and land is being provided for them elsewhere. Under the provisions of the Native Trust and Land Act, 1936, the South African Native Trust, representing the Government, is authorized to acquire 7,250,000 morgen (about 15,000,000 acres) of lands for native use. It is anticipated that the work of settling the native on these lands, which will now go on steadily, will occupy a period of several years. It is clear, however, that if the situation is not taken in hand drastically, and the conditions which prevail on native lands, not only in South Africa, but also in territories to the north, are allowed to continue unchecked, a situation similar to that for which the present measures are intended to be a remedy will again arise before many years have passed, and probably then be more difficult to meet.

THE present deplorable condition of the existing native reserves and the agitation and discontent to which the shortage of native lands has given rise is not entirely due to overpressure of population, though this has been an important factor. Traditional methods of native agriculture and grazing, of which the ill effects were negligible when a practically unlimited area allowed freedom of movement and gave exhausted soil an opportunity to recover, have led, under the system of European restriction of boundaries and suppression of tribal raids, to a general impoverishment of the land, which has further deteriorated through the erosion consequent on the overstocking which follows from the Bantu regard for cattle as a sole and almost sacrosanct form of wealth. Since the passing of the Act, the Native Affairs Commission has been busily engaged in framing a policy which is intended to remedy these adverse conditions. Regulations and remedial measures are to be applied to the existing reserves, such as fencing, irrigation, parcelling out the land for occupational and agricultural use, as well as for rotational cropping and the like, by which it is hoped to introduce into native tribal custom a more economical use of the land. On the new reserves agricultural officers will be appointed to instruct and, if necessary, discipline the natives in modern methods of cultivation. The educational process is bound to be slow; and its success, as previous experiments have shown, will depend very largely upon the discretion with which new methods are welded into traditional custom.

Physics and Society

IN an address before the American Physical Society, Washington, on April 30, on Science and Society (*J. Applied Phys.*, 8, 373; 1937), D. Sarnoff, president of the Radio Corporation of America, referred to the relation of the physicist to the far-reaching social changes which follow his discoveries. The radio industry had its origin in the purely theoretical reasoning of Clerk Maxwell when in 1865 he advanced reasons for the existence of electromagnetic waves, although it was only in 1895 that Marconi gave the world a practical system of wireless telegraphy. Already 150 social effects have been traced directly to radio, and the end is not yet in sight. The major obstacles to the public introduction of television no longer lie in the field of research and engineering. The creation of a new art form has demanded new techniques of writing, direction and studio control. Here as elsewhere a scientific approach to the solution of human problems is required, and it is essential that mankind should learn how to use the assets which are the product of the scientific mind. Civilization depends for its advance upon our expanding knowledge of the social as well as of the physical sciences, for no society can solve its problems by intuition or rule of thumb. The advance of social science no less than that of physical science, calls for the creative imagination of a Newton and a Maxwell, an Edison and a Marconi. Obsolescence is a factor in social as well as in industrial machines.

THE social investigator must approach the problems of society in the clear light of an unbiased mind. He must collect and analyse facts, seek to fathom causes and establish principles, which he must always be willing to reconsider in the light of results. The permanent advance of society depends on our following procedure similar to that of the experienced surgeon. We must not be afraid to operate but must know when a less spectacular and safer treatment will be adequate. Social and economic facts must be investigated, verified and analysed, and the analysis and conclusions disseminated widely by popular education and debate. Industry is continually entering new realms of knowledge, and close understanding and co-operation are required between its leaders and the investigators in the universities. Industry which has not learnt to employ scientific workers is doomed. Moreover, the problems created by technical science can only be solved by increasing and applying our knowledge of social science, and Mr. Sarnoff urged that the immediate goal of social science should be to achieve economic justice, peace and prosperity in a free democracy. Because that involves collective effort, it does not mean the suppression of individual liberty. Freedom of the individual is essential to the full expression of his creative faculties. Science and society depend upon each other, and when the basic lesson of science, that knowledge of the truth without fear or prejudice is indispensable to progress, is rejected, science—and society with it—goes backward instead of forward.

Education and Training for the Oil Industry

THE days when a liberal education and an effective personality were sufficient qualifications for entry into the petroleum industry are now over. As Prof. A. W. Nash pointed out in a paper presented to the Chemical Engineering Congress, World Power Conference, 1936 (*J. Inst. Pet. Tech.*, 22; 1936), specialized vocational training is the only adequate background for technical men seeking employment in the industry. Moreover, this specialized training should be directed towards one particular branch of the industry, for example, geology, production, or refining, for in each of these branches different sciences are involved and correspondingly different technical knowledge is necessary for the solution of such problems as may be encountered. Before proceeding to specialize, however, the student must acquire a sound knowledge of the fundamental principles of physics, mathematics and chemistry, together with a working understanding of engineering and chemical engineering. Finally, having mastered these fundamentals and specialized in a particular branch of the industry, the technician should familiarize himself at least with the basic principles underlying the remaining branches of the industry, for in this way alone will he acquire a clear conception of any problem which may present itself from the point of view of the industry as a whole. Universities and other institutions which provide such training for the industry, are fully alive to the fact that, apart from the actual acquisition of knowledge, the student is there primarily to learn how to apply such knowledge, to interpret it and make use of it in the solution of new problems, and their curricula are adjusted accordingly. For the man who has made full use of any such training, there are openings in the industry unrivalled in any other from the points of view of scope and advancement.

The Spread of the Sahara

THERE is abundant evidence that early in the Quaternary age the Sahara was inhabited by man and that desiccation has since been proceeding. In so far as this process is one of climatic change, it is beyond the control of man; but there is also much evidence that the increase of desert conditions in both north and south is largely due to human interference.

In a pamphlet entitled "The Threat of the Sahara", reprinted from the *Journal of the Royal African Society*, Prof. E. P. Stebbing reviews the available evidence of progressive desiccation and discusses the causes. These can be summarized as war, primitive methods of agriculture, excessive grazing and pasturage and fire. Intertribal warfare has laid waste great tracts and so promoted soil erosion. The method of shifting cultivation, entailing the cutting down of successive areas of forest and their abandonment when annual burning produces too poor a supply of fertilizing wood ash, has allowed the spread of scrub land. This degraded forest is given over to pasturage which tends to destroy the vegetation, the last stage in its use being the pasturing of goats. Prof. Stebbing sees little evidence that the desiccation can be attributed to climatic oscillations, and is extremely doubtful that the succession of a wet period will reverse the present trend.

The Zoological Society of Scotland

THE increase in the number of visitors to the Zoological Park near Edinburgh to just short of half a million, and a surplus on the year's working of £1,708, indicate the material success of this Society (*Ann. Report Zoo. Soc. Scot.*, 1936–37). In other ways it has made notable progress. The new open-air enclosure for tigers, which occupies the site of an old sandstone quarry, is a most striking example of the use of natural rock, and a new restaurant, made necessary by the increase of visitors, has been completed and opened. During the year five king penguin chicks were hatched, of which three were successfully reared, and amongst mammals there were born and reared lion cubs, four beavers, three llamas, a nilghai and Barbary sheep. The chimpanzee born in January 1936 has developed well, and for many years the breeding of tropical freshwater fishes has been a feature of the Carnegie Aquarium. A successful innovation was the holding of a series of meetings of members at which lectures upon, and illustrated accounts of, their investigations of animal habits and behaviour were given by experts.

Survey of India

IN 1905 the hope was expressed by the Survey of India that in twenty-five years maps of the whole Indian Empire on a scale of one inch to a mile would be available. The Annual Report for 1936 (Calcutta. 2*s*. 6*d*.) points out that this hope is far from realization, and that a little more than half the area is now mapped on that scale. When it was realized in 1913 that the scheme could not be completed for many years, it was decided to reduce the scale of survey for the less populous areas. As a result, two-thirds of the country is now covered by modern maps ranging in scale from one inch to a quarter inch. In the year under review more than fifty-three thousand square miles was surveyed, in addition to a certain amount of revision. The report contains full index sheets to all the scales, including the sheets of the Carte Internationale on a scale of one million which cover India and adjoining lands.

Motor-boat Speed Record

ON September 1, Sir Malcolm Campbell, driving his new motor-boat *Bluebird* on Lake Maggiore, made two runs over a measured mile at an average speed of 203·3 km. an hour. His boat is equipped with a single Rolls-Royce engine of 2000 h.p., similar to that of his motor-car *Bluebird*. Sir Malcolm has thus achieved the distinction of holding the speed record for both land and water.

Announcements

MR. J. D. GRIFFITH DAVIES, an administrative assistant in the Higher Education Department at Leeds, has been appointed assistant secretary of the Royal Society as from September 1 in succession to Mr. R. Winckworth, who at his own request has reverted to his previous position in charge of the Society's publications.

THE following appointments and promotions have recently been made in the Colonial Service: E. F. Allen, to be agricultural officer, Malaya; D. B. Fanshawe, to be assistant conservator of forests, British Guiana; D. E. Faulkner, to be veterinary officer, Gold Coast; K. D. S. MacOwan, to be veterinary officer, Kenya; J. W. Ewart, to be assistant curator of gardens, Malaya; F. R. Mason (agricultural field officer, Malaya), to be deputy director, Department of Agriculture and Fisheries, Palestine; R. W. R. Miller (director of science and agriculture, Barbados), to be director of agriculture, Zanzibar; W. D. MacGregor (senior assistant conservator of forests), to be conservator of forests, Nigeria; H. G. Wiltshire (pathologist, Zanzibar), to be senior pathologist, Uganda; W. Horsfield (staff surveyor), to be district surveyor, Lands and Mines Department, Tanganyika; H. M. Pendlebury (curator, Selangor Museum), to be director of museums, Federated Malay States; J. L. Tetley (assistant analyst, Imports and Exports Department, Hong Kong), to be chemist, Institute for Medical Research, Federated Malay States.

DR. ROBLEY D. EVANS, assistant professor of physics at the Massachusetts Institute of Technology, recently received the first Theobald Smith award in medical science, consisting of a bronze medal and one thousand dollars, for his researches, which have led to a method of detecting radium poisoning before its fatal stage and a treatment for extracting radium from bones.

A USEFUL little volume on most aspects of map-making has been published under the title of "Cartography" (Special Publication No. 205. U.S. Dept. of Commerce. Coast and Geodetic Survey 1936. 60 cents). The pamphlet opens with a short historical survey, after which is a discussion of different kinds of maps and charts and their requirements. Then follows a chapter on compilation of the material for a map and a clear, though brief, account of the chief projections. The last section treats of the technique of construction. There are many reproductions of sections of various maps, American and others.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 468.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Asymmetry in Metals of Hexagonal Structure

THE axial ratio, c/a, of the majority of metals having a hexagonal close-packed type of structure differs appreciably from the value $2\sqrt{2/3} = 1\cdot633$ which corresponds to a hexagonal close-packed system of spheres. The two most notable deviations are for zinc and cadmium, for which $c/a = 1\cdot86$ and $1\cdot89$ respectively, while for beryllium, titanium, zirconium, hafnium, yttrium, ruthenium and osmium, c/a lies between 1·58 and 1·59. These facts have sometimes been expressed by describing the atomic domains as having the forms of prolate and oblate spheroids when c/a is respectively greater than and less than 1·633; but it is only recently that experimental evidence has been obtained which throws light on the nature of the asymmetry in these metals.

X-ray measurements for zinc[1] and cadmium[2] have shown that the atomic vibrations in these metals are markedly asymmetric, the mean atomic displacement along the hexagonal axis, the c-axis, being greater than normal to the axis; this suggests that the high values of the axial ratios arise partly, if not wholly, from the asymmetric character of the vibrations. This is further supported by X-ray measurements by us for magnesium[3], similar to the previous experiments on zinc and cadmium, which indicate that the lattice vibrations in magnesium are much more nearly isotropic; this may be correlated with the fact that c/a for magnesium is 1·624, which approximates closely to the ideal value, 1·633.

Results have recently been obtained, however, indicating the existence of an appreciable atomic asymmetry. It was first pointed out by one of us[1,2] (G. W. B.), that the $(10\bar{1}0)$ reflections from zinc and cadmium give abnormally high scattering factors compared with the adjacent reflections, and since these reflections occur at small angles for which lattice vibration has relatively little effect, it was thought that it might be an indication of atomic asymmetry. This has since been confirmed in the case of zinc by Jauncey and Bruce[4], who also have accepted it as evidence for atomic asymmetry, and by other workers in Jauncey's laboratory[5]; Wollan and Harvey[6] especially have carried the matter a step further by making measurements at two temperatures. In the light of this evidence, it appears well established now that the atoms in metallic zinc and cadmium are asymmetric and are more diffuse along the c-axis than normal to it.

We have recently investigated ruthenium, a hexagonal metal with $c/a = 1\cdot58$, which has provided evidence for a different type of atomic asymmetry. The lattice vibrations at room temperature are relatively small, so that this metal is particularly suitable for studying atomic asymmetry. The X-ray scattering factors of ruthenium are shown in Fig. 1, the length of the line attached to each reflection indicating the possible experimental error. Among the lower order reflections, 2 and 5 are well above the mean curve and 1, 3, 4 and 6 fall either on or below the curve, depending on how it is drawn. The indices of the reflections are given in the key attached to the figure. The curve is extrapolated to 42·8 at $(\sin\theta)/\lambda = 0$, which is the atomic number, 44, less a dispersion correction of 1·2. An interesting feature of these results is that whereas the second reflection comes from the basal plane, the fifth reflection, which is also high, comes from a plane parallel to the c-axis, that is, normal to the basal plane. Evidently, then, a simple extension of the atoms either in the direction of the c-axis or in the basal plane will not explain these results.

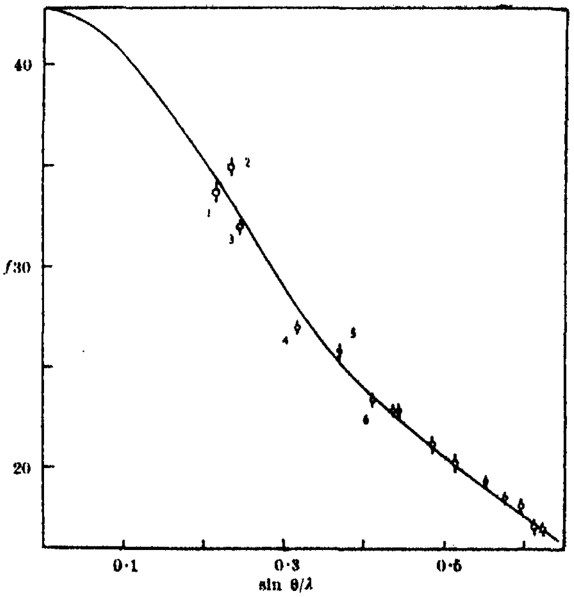

Fig. 1.

X-RAY SCATTERING FACTOR OF RUTHENIUM

1, $10\bar{1}0$	4, $10\bar{1}2$
2, 0002	5, $11\bar{2}0$
3, $10\bar{1}1$	6, $10\bar{1}3$

An explanation is obtained, however, if we suppose that there is a concentration of electron density having its centre of gravity at the mid-point of every triangle formed by three atoms in the basal plane, as in Fig. 2, where the black circles represent the atoms and the clear circles the additional electron density. It is seen that the additional charge lies between planes of the type $(10\bar{1}0)$, $(10\bar{1}1)$, $(10\bar{1}2)$, etc., corresponding to reflections 1, 3, 4 and 6, and so gives low scattering factors, but lies on planes of the type $(11\bar{2}0)$ and also on the basal plane (0001), the plane of the diagram. As to why there should be a concentration of electron density, which need only be of the order of 1–2 electrons to account for the observations, we cannot yet say; but it may perhaps be due to the overlapping of the wave-functions of the incomplete 4*d* shell, which for ruthenium have a considerable spread. An objection to this simple explanation is that it would require concentrations of electron density at other points in the lattice which would not agree with the present observations. Whatever may be the ultimate explanation, however, the experimental results point strongly to a concentration of electron density of the type indicated in Fig. 2.

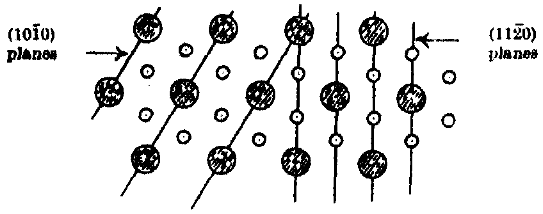

Fig. 2.

G. W. BRINDLEY.
(Mackinnon Student of the
Royal Society.)
P. RIDLEY.

Physics Laboratories,
The University,
Leeds.
July 7.

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[1] Brindley, G. W., *Phil. Mag.*, 21, 790 (April 1936).

[2] Brindley, G. W., *Proc. Leeds Phil. Soc.*, 3, 200 (April 1936).

[3] Brindley, G. W., NATURE, 138, 290 (August 15, 1936).

[4] Jauncey and Bruce, *Phys. Rev.*, 50, 408 (1936).

[5] Miller and Foster, *Phys. Rev.*, 50, 417 (1936). Miller, *Phys. Rev.*, 51, 959 (1937).

[6] Wollan and Harvey, *Phys. Rev.*, 51, 1064 (1937).

A New Equilibrium Diagram for the System Fe—C

Two equilibrium diagrams, the single diagram and the double diagram, have been proposed for the system Fe—C and we cannot, as yet, decide upon which is the correct one. The single diagram assumes that graphite never separates directly from molten iron, which was, however, recently experimentally disproved by different workers including myself. It meets with a second difficulty as it represents a metastable equilibrium; but a stable diagram for such an important alloy as Fe—C is required.

The double diagram indicates that graphite may sometimes be formed directly from the melt; it is free from the above difficulties, but it encounters more as follows:

(1) Two diagrams (stable and metastable) are drawn with an interval less than 10° C., and such a coupled diagram makes the matter difficult to understand. Several double diagrams have been proposed by different authors, and it is extremely difficult to chose from them.

(2) Two eutectic temperatures (austenite-cementite and austenite-graphite) are expected by the double diagram, but many authors have been able to find only one.

(3) The lower (metastable) lines of the double diagram express a super-cooling. We have now about 400 binary equilibrium diagrams and only three of them, Cd—Sb, Cd—As, Fe—C, include super-cooling. Super-cooling in the systems Cd—Sb and Cd—As is abnormal. Ordinary super-cooling is added only in the double diagram of Fe—C, which is unreasonable. We must have important reasons to justify the addition of super-cooling in the diagram, and the metastable equilibrium lines added should have been clearly proved by experiment; but neither condition is fulfilled. The double diagram includes the super-cooling at the eutectic but not that at the eutectoid (martensite formation is never included). This, again, is a self-contradictory feature of the double diagram.

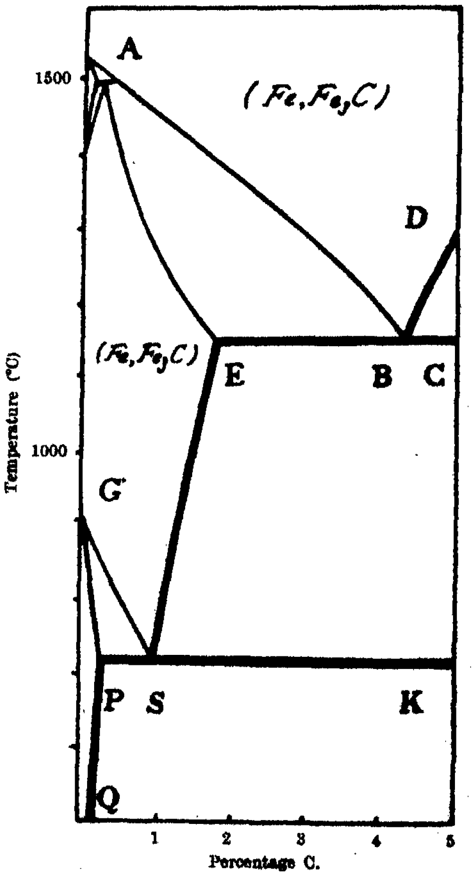

Fig. 1.

NEW EQUILIBRIUM DIAGRAM. LOW TEMPERATURES: STABLE EQUILIBRIUM FE—C; HIGH TEMPERATURES: STABLE EQUILIBRIUM FE—FE_3C.

Fig. 1 *shows* a new equilibrium diagram. Super-cooling is omitted, thus avoiding all the difficulties of the double diagram. It shows a stable equilibrium, assuming Fe_3C to decompose on solidifying or on separating from austenite, eliminating the two difficulties of the single diagram.

The details will be published in the report of this Institute.

ICHIRÔ IITAKA.

Institute of Physical and Chemical Research,
Tokyo, Japan.
July 9.

Diffraction of Slow Positive Ions

AN experimental method has been developed which permits photographic recording of the scattering of slow positive ions through angles of a fraction of a degree. This is accomplished by using a very fine, electrostatically focused incident beam and accelerating the ions, *after the scattering*, to a velocity high enough to affect a photographic plate. The high-voltage electrostatic lens used to give the acceleration also produces an angular magnification of the scattered rays.

Fig. 1 shows the scattering of lithium ions by a jet of sodium vapour, photograph *a* for 292 volt ions, *b* for 149 volt ions. Around the central spot is a sharply defined disk of nearly uniform intensity, having an angular radius of 0·0083 radians for the faster ions and 0·0151 for the slower ions. The plates also show a faint halo surrounding the disk and separated from it by about a quarter of the disk's diameter.

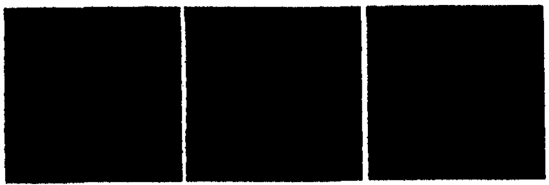
a *b* *c*

Fig. 1.

The pattern appears, at first sight, to resemble the diffraction of light by an opaque circular obstacle. However, a wave theory in which the atom and ion are treated as hard spheres gives a value of only 1 A. for the collision radius and also predicts a wrong variation of disk radius with ion energy. The repulsive field model considered theoretically by Massey and Smith[1] gives a monotonic decrease of elastic scattering with increasing angle and therefore also fails to account for the effects.

A satisfactory explanation of the results has been found which seems definitely to establish the wave nature of lithium ions. The essential features of the theory are the inclusion of the attractive force due to polarization of the sodium atom, and the division of the ion wave-front into three distinct parts corresponding, respectively, to exceedingly small, large and intermediate scattering angles.

The first part is taken in such a way that the retardation produced by the potential field of the atom is everywhere less than half a wave-length. Under these conditions there is negligible refraction of the wave-front and only slight diffraction corresponding to a large circular obstacle (in atomic units). This gives a central Airy's disk of about 0·0006 in angular radius, which is considerably less than the angular radius of the incident beam. The second or innermost part of the wave-front is where the retardation varies very rapidly, corresponding to large angle scattering.

The remaining annular part of the wave-front is what produces the observed pattern. Now, the calculations show that the retardation varies almost linearly across the width of this region and a hollow cone of rays would therefore be produced, were it not for diffraction. This has the effect of filling up the inside of the cone and also producing fringes, spaced in accordance with the width of the annulus. The fringes inside the cone are smoothed out by overlapping, thereby giving the observed uniform disk. The separation of the halo from the edge of the disk is related directly to the width of the annulus.

The calculations have been made for a force of the form[2]

$$F(r)=\frac{2\alpha e^2}{r^5}\left[1-\left(\frac{r_0}{r}\right)^4\right]$$

where α is the polarizability of the sodium atom and r_0 the equilibrium nuclear separation of Na Li+. For both 292- and 149-volt ions the observed radii of disk and halo agree, within the limits of the experiment, with those calculated for $\alpha = 2\cdot5 \times 10^{-23}$cm.[3] and $r_0 = 2\cdot36$A. Since only two observations are needed to fix both α and r_0, this means that the theory correctly accounts for the observed variation of both radii with energy. The value of α fits in with the values found experimentally for Li, K and Cs by Scheffers and Stark[3], and r_0 is consistent with the spectroscopic values[4] of 2·67 and 3·07 for the neutral molecules Li_2 and Na_2. From the values of α and r_0 the binding energy of Na Li+ works out at 2·9 volts.

Fig. 1, *c*, shows the grazing-angle scattering of 292-volt lithium ions by a red-hot nickel target. As with sodium, there is a sharp intensity discontinuity, but the pattern has an approximately elliptical, and not circular, outer boundary.

A qualitative explanation of the effect is possible in terms of diffraction by single protruding surface atoms, using the same annular slit model as before, but with some allowance for the underlying atoms. The latter have the effect of smoothing out the potential behind the diffracting atom and consequently lessening the retardation gradient across the slit at that point. The pattern should accordingly be contracted in a direction normal to the target surface, as it actually is. It must be noticed that the retardation gradient across the slit bends the wave-front *towards the atom*, and therefore the part of the wave-front passing in front of the atom does not contribute to the pattern.

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[1] *Proc. Roy. Soc.*, A, **142**, 142 (1933).

[2] Hassé and Cook, *Phil. Mag.*, **12**, 554 (1931).

[3] *Phys. Z.*, **35**, 625 (1934).

[4] Sponer, "Molekülspektren, 1", Tabellen.

Vibration Temperature in relation to Rotation Temperature in Band Spectra

THE problem of exciting band spectra of two different molecules in the same source has attracted some attention of late. Investigation of excitation temperatures of molecules under these conditions has given interesting results which require elucidation from theory. For example, Lochte-Holtgreven[1] found by examining CH and C_2 bands in the same discharge tube a temperature difference of more than 1,000° between the two. On the other hand, van Wijk[2] arrived at a common effective temperature from the negative (N_2^+) and second positive (N_2) bands of nitrogen in the same discharge tube. In view of these results, it was deemed necessary to undertake further work on the same lines.

The present investigation deals with AlO blue-green and CN violet systems excited in the same arc and photographed simultaneously. The gross intensity measurements of all the bands in the two systems have been made by the methods of photographic spectral photometry by comparison with a standard source of known energy distribution. On the assumption of a Boltzmann distribution of vibrational energy in the initial state, temperatures have been calculated. These are shown below and compared with the results from the rotational energy distribution of previous authors for the same molecules examined in the carbon arc.

Band systems	Vibration temperatures (T. and T.)	Rotation temperatures (Ornstein and Brinkman)
CN, $B^2\Sigma \rightarrow x^2\Sigma$	6200° K.	6500° K.
AlO, $^2\Sigma \rightarrow {}^2\Sigma$	3450° K.	3275° K.*

* This is taken as the mean of two temperatures from 0,0 and 1,0 bands of AlO

It may be noted that the effective vibration temperatures of column 2 above agree fairly closely with the rotation temperatures of Ornstein and Brinkman. They are an indication of temperature equilibrium in the source (carbon arc) examined, as the values are supposed to be in the neighbourhood of the true temperatures for the zones concerned, for the CN bands are emitted from the inner violet part and AlO bands from the outer green halo.

The details of the investigation are being published elsewhere in a separate paper.

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Z. Phys., 64, 443 (1930); 67, 590 (1931).

[2] *Z. Phys.*, 59, 313 (1930).

[3] *Proc. K. Acad. Amsterdam*, 34, 498 (1931).

Intensity and Structure Changes of the $L\alpha$ Emission Lines of Cu and Fe on Intense Cooling of their Anticathodes

THE only previous experiments on the effects of temperature of the anticathode on the changes in the character of X-ray lines either in absorption or emission, are those of H. S. Read[1], J. H. Purks[2] and F. C. Chalklin[3]. These investigations, as also those of J. D. Hanawalt[4], who studied changes in the fine structure of X-ray absorption spectra dependent on the physical and chemical nature of the absorber and temperature, were all concerned with the effects of high temperature alone. So far as we are aware, except for the experiment of Swedenborg and Claesson[5], whose results were published while our experiments were in progress, there seems to be no record of any experimental investigations of the effect on the character of the X-ray lines emitted of intensely cooling an anticathode.

For effectively cooling the target, we had recourse to rapid evaporation of liquid oxygen from a specially designed anticathode tube. A plane grating spectrograph of the type devised by Siegbahn and Magnusson and constructed by Messrs. Adam Hilger, Ltd., was employed; while a molecular pump supplied by Leybold Nachfolger backed by a suitable oil pump was used for exhausting the apparatus. The grating used was ruled at Uppsala and had 900 lines in a space of 3 mm. Exposures were made first with liquid oxygen evaporating and then with tap water circulating through the anticathode tube, on the same photographic plate. The time of exposure, bombarding electronic current (70 ma.) and the accelerating potential (4·8 kV.) were all kept constant during the two exposures. Although the grating used did not possess sufficient dispersion to resolve the L lines clearly, making quantitative measurements difficult, yet microphotometric studies of the photographs obtained have yielded the following interesting preliminary results:

(*a*) The line-curves of Cu and Fe L-lines possess considerable spread on the long-wave side but are steeper on the short-wave side at both the liquid oxygen temperature (– 183° C.) and room temperature (25° C.) of the targets.

(*b*) The intensity of the Cu $L\alpha$-line at the liquid oxygen temperature of the target is only 70 per cent of that from the target at room temperature. The corresponding figure for Fe is about 60 per cent.

(*c*) Although L-lines are not clearly resolved by the spectrograph used, which has a dispersion only of 4·95 A. per mm., there is unmistakable evidence of their shift relatively to one another with the temperature change of the target.

(*d*) Some changes in the widths of the lines are also suggested with the change of temperature of the target.

The experiment is being repeated with a new plane grating possessing double the dispersion of the former, the experimental arrangements remaining more or less the same. It is hoped that it will be possible, on the conclusion of the experiments now in progress, to give definite quantitative results of measurements.

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July 17.

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[1] Read, H. S., *Phys. Rev.*, 27, 373 (1926).

[2] Purks, J. H., *Phys. Rev.*, 29, 352 (1927).

[3] Chalklin, F. C., *Proc. Roy. Soc.*, A, 155, 366 (1936).

[4] Hanawalt, J. D., *Phys. Rev.*, 37, 715 (1931); 41, 399. (1932).

[5] Swedenborg, H., and Claesson, M., *Ann. Phys.*, 28, 159 (1937).

Surface Tension of Strong Electrolytes

Jones and Ray[1] have recently found that on adding a salt to water the surface tension at first decreases, then passes through a minimum and finally at concentrations above about 0·001 N increases with increase of concentration. The interionic attraction theory of surface tension developed by Wagner[2] and Onsager[3] on the basis of the Debye solution theory and the principles of electrostatics requires, however, the slope of the surface tension - concentration curve always to be positive and greater at the lower concentrations. The accurate results of Jones and Ray are thus seen to be in complete disagreement with theory.

By postulating that the surface structure of water is such that there is a small number of surface locations where negative ions can become adsorbed from the interior of the solution with a large diminution of potential energy, it is possible to derive statistically the following equation for the number of moles of an ion kind adsorbed per sq. cm.

$$\Gamma_i = ck\nu_i\left[\frac{a - (b - ck\Sigma\nu_i)e^{W_-/RT} - ck\nu_-}{(b - ck\Sigma\nu_i)e^{W_-/RT} + ck\nu_-}\right] \quad (1)$$

which when coupled with the Gibbs adsorption isotherm yields (neglecting activity coefficients)

$$\gamma - \gamma_0 = RTkc\Sigma\nu_i + \frac{aRT\Sigma\nu_i}{e^{W_-/RT}\Sigma\nu_i - \nu_-} \ln\left[l - \frac{\{e^{W_-/RT}\Sigma\nu_i - \nu_-\}kc}{be^{W_-/RT}} \right] \quad (2)$$

The term $e^{W_-/RT}\Sigma\nu_i$ can be shown to be very much smaller than ν_-, with the result that (2) reduces to

$$\gamma - \gamma_0 = RTkc\Sigma\nu_i - \frac{aRT\Sigma\nu_i}{\nu_-} \ln\left[l + \frac{k\nu_- c}{be^{W_-/RT}} \right] \quad (3)$$

where γ is the surface tension at concentration c (moles per litre), a is the number of adsorbing points per sq. cm., b is the number of water molecules per sq. cm., W_- is the potential energy of the negative ion at the surface in excess of its value in the interior of the liquid, and k is the ratio between the concentration in moles per sq. cm. and moles per litre, and depends on the thickness of the adsorbed layer, which we take as the diameter of the water molecule plus that of the adsorbed solute.

Knowing the diameters of the water molecule and of the solute ions, and estimating a and W_- from the data of Jones and Ray, it is possible to calculate the surface tension from (3) for potassium chloride solutions, for example (lower solid line of Fig. 1), and to compare with the experimental results (crosses of Fig. 1). The agreement is satisfactory.

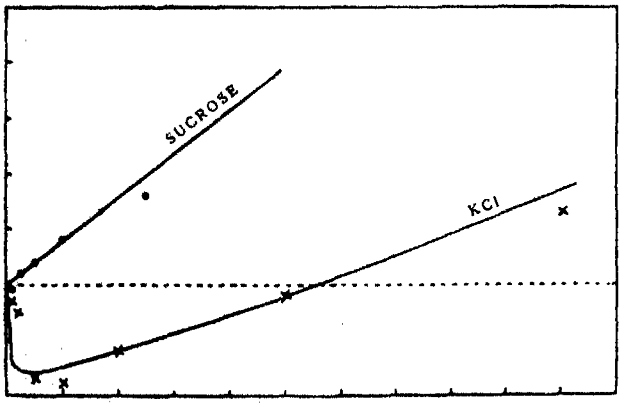

Fig. 1.

In the case of capillary inactive non-electrolytes like sucrose, a will be equal to zero and (3) becomes

$$\gamma - \gamma_0 = RTkc. \quad (4)$$

From the density of solid sucrose one can calculate an approximate value of its molecular diameter allowing an evaluation of k to be made and a computation of the surface tension from (4). The upper solid line of Fig. 1 represents the theoretical calculations, while the circles are the experimental data of Jones and Ray. Again the agreement seems to be satisfactory, and lends support to the original postulate.

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July 19.

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[1] Jones, Grinnell, and Ray, W. A., *J. Amer. Chem. Soc.*, 59, 187 (1937).

[2] Wagner, C., *Phys. Z.*, 25, 474 (1924).

[3] Onsager, L., and Samaras, N. N. T., *J. Chem. Phys.*, 2, 528 (1934).

Viscosity of Monomolecular Films

ALTHOUGH the viscosity relations of films are of fundamental importance for an understanding of their structure, it has not in the past been possible, with the surface viscosimeters used, to determine the viscosity of a true film, that is of a monolayer. Two viscosimeters which are sufficiently sensitive are described below, and others are in process of development.

1. *Capillary slit viscosimeter for liquid surface films.* The film is allowed to flow under its own pressure, or a difference of pressure, through a long transverse slit in a barrier which confines the film. The following relation gives the viscosity (η):

$$\eta = \frac{f}{Q}\,\frac{d^3}{12l} \text{ dyne sec. cm.}^{-1},$$

where f is the surface pressure in dynes per cm., d is the diameter, and l the length of the slit, and Q is the number of sq. cm. of film which disappears through the slit per second.

VISCOSITY OF SURFACE FILMS OF FATTY ACIDS IN SURFACE POISES

No. of C Atoms	Saturated Acids at 25°C.	
14	Myristic	0·000161
15	Pentadecylic	0·000228
16	Palmitic	0·000248
17	Margaric	0·000317
18	Stearic	0·000307
19	Nonadecanoic	plastic solid
20	Arachidic	0·001790
	Unsaturated Acid at 20°C.	
18	Oleic	0·000162

2. *Torsion ring surface viscosimeter for liquid and plastic-solid films.* A torsion pendulum, with a horizontal circular disk at the bottom, was constructed. This disk may be allowed to vibrate in the surface, but is insensitive to the film. A thin metal cylinder, 1 cm. high, was soldered to the outside of the ring in such a way that only the sharp lower edge of this cylinder could be put in contact with the surface of the water. By allowing this ring (10 cm. in diameter) to vibrate in contact with the clean surface, and then with a film outside, but not inside the ring, the viscosity of the film could be calculated from the logarithmic decrements of angle between successive swings.

This instrument gave data of great interest. For example, cetyl alcohol on 0·01 molar hydrochloric acid at 22° C. compresses at very low pressure to a liquid monolayer of 21 sq. A. area per molecule. As the pressure is increased, the viscosity of the liquid film increases, as is shown by both types of viscosimeter. The force-area relation is linear to 11 dynes and 19 sq. A., and at this kink point a change of phase occurs, in which a plastic solid film of very much higher viscosity and lower compressibility appears. The viscosity of this film increases rapidly with pressure. Pentadecylic acid, which forms an expanded film the pressure of which begins to increase above 0·1 dyne per cm. at 44 sq. A., forms a liquid film both below and above the kink, and the solid plastic form appears where no kink is visible at a molecular area of 21 sq. A.

The viscosity of monolayers is found to be highly dependent upon the tightness of packing of the molecules in the film, and, as the table indicates, it increases rapidly with the length of the molecule in condensed films which exhibit an orientation of the molecules perpendicular to the surface.

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Spectroscopic Observations of Reactions between Lactoflavin, the Coulter Compound, 'Cytochrome *b*', and Cytochrome *c*

FROM diphtheria toxin, one of us (M. D. E.) has prepared a solution continuing the "complex porphyrin" of Coulter[1], and also a compound characterized by an α-band located in the same position as that of cytochrome *b* (563 mμ). The preparation will be described elsewhere.

When oxidized lactoflavin was added to this solution, at 30° C. and *p*H 7·4, the 574 mμ and 563 mμ bands disappeared instantly. When lactoflavin was reduced by hydrosulphite, the 574 mμ and 563 mμ bands reappeared at once. The 574 mμ and 563 mμ compounds must therefore be in the reduced state.

Reduced cytochrome *c* was added next to this solution. A paradoxical phenomenon was observed: the 574 mμ and 563 mμ bands again disappeared, as if reduced cytochrome *c* had oxidized the reduced 574 mμ and 563 mμ substances. Cytochrome *c* was obtained from a stock solution by acetone precipitation; the stock solution had been prepared in Prof. Keilin's laboratory by Dr. F. Stare.

In a separate experiment, oxidized cytochrome *c* was added to the solution of 574 mμ and 563 mμ substances. All the bands remained unchanged, indicating that no reaction had occurred.

Lactoflavin is not necessary for the reaction between reduced cytochrome *c* and the reduced 574 mμ and 563 mμ substances. This was shown by adding reduced cytochrome *c* to the 574 mμ and 563 mμ compounds. The 574 mμ and 563 mμ bands disappeared. This reaction can be partly reversed by the immediate addition of a few drops of 5 per cent potassium ferricyanide solution. Oxidized cytochrome *c* appears, and the 574 mμ and 563 mμ bands re-appear in diminished strength. The 574 mμ and 563 mμ substances alone do not react with ferricyanide. A solution containing the 574 mμ compound alone reacted exactly like the mixture of the 574 mμ and 563 mμ compounds.

The following hypothesis summarizes the observations and interprets the paradox: when the iron atom of cytochrome *c* is in the divalent state, the 574 mμ and 563 mμ compounds can be oxidized by the porphyrin ring of cytochrome *c*; but when the iron is in the trivalent state, the porphyrin ring cannot oxidize the 574 mμ and 563 mμ substances.

These reactions between cellular catalysts are interesting in themselves. In addition, a more exhaustive investigation will bring out whether or not they are related to the Pasteur reaction.

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[1] Coulter and Stone, *J. Gen. Physiol.*, 14, 583 (1930/31).

Oxidation of Cholesterol and Dehydroandrosterone by Means of Osmic Acid

UNSATURATED compounds are known to add, under the action of osmic acid, two hydroxyl groups at the place of their double bond[1], these groups being in *cis*-position with regard to each other. The reaction course is analogous to that produced by $KMnO_4$. However, action of the latter on cholesterol[2] yields but 4–5 per cent of *cis*-cholestan-triol. Thus $KMnO_4$ is unsuitable for the oxidation of the double bond in sterol-derived hormones, in particular in dehydroandrosterone.

After we had obtained *trans*-androstan-(17)-one-(3, 5, 6)-triol from dehydroandrosterone oxide[3] we desired to obtain also the *cis*-compound for the sake of comparing their physiological activities. The method has been worked out for cholesterol[4], then transferred to dehydroandrosterone.

Equivalent amounts of anhydrous cholesterol and osmic acid, dissolved in water-free ether, are allowed to react for 2–3 days. The ether is then distilled off and the black residue boiled with an aqueous-alcoholic solution of Na_2SO_3 for two hours. When working with cholesterol only traces of the looked-for product—cholestan-triol—are found in the water-alcohol filtrate; most of it is obtained by extracting the black residue with boiling alcohol. The *cis*-cholestan-triol obtained melted, after washing with ether, at 238·5–239·5°. Mixed with the *trans*-compound it caused depression of the melting point.

On oxidizing dehydroandrosterone with OsO_4 almost the whole of the androstanone-triol passes into the aqueous-alcoholic solution (after boiling with sulphite). Yield of the crude product: 70 per cent. Recrystallized from ethyl-acetate; transparent rectangular prisms, m.p. 243·5–244° (corr.; sinters at 242·5°). Analytical data agree with the formula $C_{19}H_{30}O_4$.

We intend applying the same method also to androstene-diol, androstene-dione and testosterone.

The present work is to be published shortly in detail.

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[1] Details in the recent paper by Criegee, R., *Ann.*, 522, 75 (1936), where the literature is cited.

[2] Windaus, A., *Ber.*, 40, 257 (1907).

[3] Ushakov, M., and Lutenberg, A., "Dehydroandrosterone oxide", in press in *Journal Obshchei Chimii* and *Bull. Soc. Chim. de France.*

[4] Criegee (*loc. cit.*) mentions having obtained some *cis*-diols of the sterol group; he does not give any details, nor mention what sterols he worked with.

Decomposition of Benzene-Diazonium Chloride

To test the suggestion[1] that the decomposition of aromatic diazo compounds might be non-ionic in mechanism, I have been investigating the decomposition of benzene-diazonium chloride in the presence of non-aqueous solvents. When suspended in an organic liquid, benzene, diazonium chloride appears to melt at about 50° C. and then immediately a violent decomposition sets in. There is great heat evolution, and, except on the small scale, the reaction tends to become explosively violent. Often hydrogen chloride is evolved, and whenever its formation has been observed, chlorobenzene has been found amongst the reaction products.

From an examination of the decomposition in acetone, it appears possible that the chlorobenzene is produced by a secondary reaction between the decomposing benzene-diazonium chloride and the hydrogen chloride, since when an excess of chalk is added to keep the mixture neutral, the principal reaction that occurs is

$$Ph.N_2.Cl + CH_3.CO.CH_3 = N_2 + Ph.H + Cl.CH_2.CO.CH_3\,;$$

for both benzene and chloroacetone were isolated in good yield.

Since chloride anions do not attack acetone, it follows that the decomposition of benzene-diazonium chloride, $(Ph.N_2)^+Cl^-$, is not a direct decomposition of a diazonium cation, nor yet an intramolecular process. The mechanism:

$$\underset{\text{diazonium salt}}{(Ph.N_2)^+Cl^-} \rightarrow \underset{\text{covalent diazo-compound}}{Ph-N=N-Cl} \rightarrow \underset{\text{free neutral radicals}}{N_2 + Ph\cdot + \cdot Cl}$$

will accord with facts. When this decomposition in acetone, kept neutral with chalk, is carried out in the presence of the relatively inert metals antimony, bismuth, lead and mercury, a rapid reaction occurs at room temperature and the metal is attacked. With mercury, phenyl-mercuric chloride is produced.

These reactions with metals are undoubtedly similar to those which I have previously observed during the decomposition of benzene diazo-acetate[1], and are closely paralleled by the observations of Nesmejanov and his colleagues[2], who have obtained organometallic compounds by decomposing certain diazonium double salts with metals such as copper, tin and zinc.

To substantiate the experimental evidence reported above, the work is being extended to reaction in other organic liquids.

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Aug. 6.

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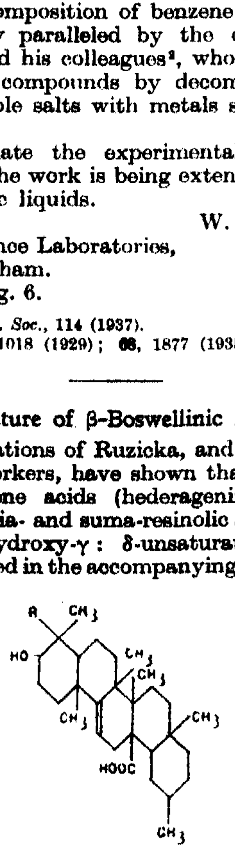
[1] Waters, *J. Chem. Soc.*, 114 (1937).
[2] *Ber.*, **62**, 1010, 1018 (1929); **68**, 1877 (1935).

Structure of β-Boswellinic Acid

THE investigations of Ruzicka, and of Winterstein and their co-workers, have shown that the majority of the triterpene acids (hederagenin, gypsogenin, oleanolic acid, sia- and suma-resinolic acids) are in all probability θ-hydroxy-γ : δ-unsaturated mono-basic acids, as indicated in the accompanying formula[1]. On the other hand, β-boswellinic acid, $C_{29}H_{46}(OH)COOH$, one of the principal triterpene constituents of frankincense, evidently possesses a somewhat different constitution, for on mild oxidation with chromic anhydride this acid is converted into a monoketone $C_{29}H_{46}O$, m.p. 196° (found: C, 84·53; H, 11·11. $C_{29}H_{46}O$ requires C, 84·80; H, 11·30 per cent), which has been characterized by the preparation of an oxime. Oxidation under similar conditions of β-boswellinic methyl ester, however, furnishes the corresponding keto-ester, m.p. 160° (found: C, 79·12; H, 10·20. $C_{31}H_{48}O_3$ requires C, 79·41; H, 10·33 per cent), which forms an oxime, m.p. 200°.



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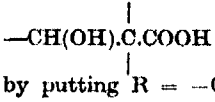
These findings necessitate the assumption that β-boswellinic acid is a β-hydroxy-acid, the expected facile elimination of carbon dioxide from the β-keto-acid first formed during the oxidation giving rise to the ketone $C_{29}H_{46}O$. The requisite grouping



$$-CH(OH).\overset{|}{\underset{|}{C}}.COOH$$

may be derived from structure I by putting R = —COOH.

It is of interest to note that in gypsogenin R = —CHO, and in hederagenin R = $-CH_2OH$, and it is significant that oxidation of the primary alcoholic group of the latter compound gives a β-hydroxy-acid, the further oxidation of which is exactly analogous to that of β-boswellinic acid[2].

A full account of this investigation will be published elsewhere.

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July 26.

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[1] Ruzicka, Goldberg, and Hofmann, *Helv. chim. Acta*, **20**, 325 (1937).
[2] Jacobs and Gustus, *J. Biol. Chem.*, **69**, 641 (1926).

Succession of Broods in *Lebistes*

IN connexion with the note by G. L. Purser in NATURE of July 24 on "Succession of Broods of *Lebistes*", it has long been known that several of the viviparous fish, such as *Lebistes*, are fertilized for a long time after one copulation. E. Philippi has described this phenomenon in *Glaridichthys*[1]. Johs. Schmidt found it in *Lebistes*[2]. He says that he had observed seven broods in succession. I have noted up to eight broods[3].

In my paper in 1922 I gave a photomicrograph showing the spermatozoa lying ready in the ovary for the next fertilization, with their heads as near the immature eggs as possible. Plainly enough there is competition between the spermatozoa, and it is remarkable that when a female has been fertilized by a male of one race of *Lebistes* and has produced some few broods within a few months, and then a new male of another race of *Lebistes* is put into the tank immediately after a birth, the next brood will be from fertilization by the new male. The old spermatozoa cannot compete with the fresh ones. Ordinarily a mixed brood is only obtainable when both males are together with the female at the same time.

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August 13.

Zoo. Jahrb., **27** (1908).
[2] *Comptes-rendus Laboratoire Carlsberg*, 14 (1920).
[3] *J. of Genetics*, **12** (1922); **18** (1927).

Homologous Loci in Wild and Cultivated American Cottons

ON cytological grounds[1], the New World cultivated cottons are thought to be allopolyploids with two genoms each of thirteen chromosomes derived from species cytologically homologous with the present Asiatic *arboreum-herbaceum* group of species and with the North American thirteen chromosome species (*aridum*, *Armourianum* and *trilobum*). Genetical confirmation of the part played by the present cultivated Asiatic cottons or their ancestors in the origin of the New World cultivated group, was later provided by my demonstration[2] that a gene could be transferred from an Asiatic to a New World cotton by repeated back-crossing.

Genetical confirmation is now available regarding the existence in the thirteen-chromosome North American species of genes which have alleles in the cultivated cottons with $n = 26$ chromosomes. Hybrids between *G. barbadense* L. (Sea Island) and the wild species *G. aridum*, *G. Armourianum* and *G. trilobum* were found to be weakly fertile on the male side. After making two successive back-crosses of the hybrids with *barbadense* or *hirsutum*, fertility was completely restored, and the following transferences of genes from the wild to the cultivated species were effected :

1. Normal (C^r) from *aridum* to *barbadense* (c^r).
2. Normal (C^r) from *Armourianum* to *barbadense*. (c^r).
3. Normal (C^r) from *trilobum* to *barbadense* (c^r).
4. (S^E) Petal Spot from *aridum* to *barbadense* and *hirsutum*.
5. (S^{AR}) Petal Spot from *Armourianum* to *barbadense*.

The slight impairment of dominance of the crinkled heterozygotes of *aridum* and *trilobum* which persists in the second back-cross of *barbadense* crinkled, suggests that the normal alleles of these species may not be identical with the *barbadense* normal allele, but may differ in dominance potency. If they prove to differ in this way, they will resemble the weaker normal alleles at this locus established to be present in upland cotton (*G. hirsutum* L.).

The genes for petal spot of *aridum* and *Armourianum* respectively appear to be different from the petal spot genes of either *barbardense* or *hirsutum*, but their relationship with the spot genes of these species has not yet been elucidated.

To sum up : it is now established on genetical as well as cytological grounds that the New World cultivated cottons are amphidiploid in origin and that thirteen-chromosome species from both Asia and North America have played a part in their formation. My previous hypothesis[2] that the New World group originated in late Cretaceous or early Tertiary time in a former Polynesian land mass also receives further support.

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[1] *Ann. Bot.*, **47**, 227 (1933). *J. Genet.*, **28**, 407 (1934). *Emp. Cotton Grow. Corp.*, Rept. 2nd Cong., 46 (1934). *J. Genet.*, **30**, 447. *J. Agric. Res.*, **51**, 1047.

[2] *J. Genetics*, **30**, 465.

Points from Foregoing Letters

Dr. G. W. Brindley and P. Ridley discuss the two kinds of asymmetry found in certain metals having a hexagonal structure—asymmetry of the lattice vibrations and asymmetry of the atoms. It is pointed out that in ruthenium the atomic asymmetry is of a different type from that found in zinc and cadmium.

A new equilibrium diagram for the system iron-carbon has been prepared by Dr. I. Iitaka. The author claims that it eliminates the difficulties of the 'single' diagram by assuming Fe_3C to decompose on solidifying or on separating from austenite, and overcomes those of the 'double' diagram by omitting super-cooling.

Photographs showing the scattering of lithium ions by sodium vapour and by a red-hot nickel target (at grazing angle) are submitted by A. G. Emslie, who also supplies an explanation which, he considers, establishes the wave nature of the lithium ions.

By photographing AlO blue-green and CN violet bands simultaneously in the same arc, gross intensities of both have been measured by Dr. N. R. Tawde and S. A. Trivedi by the methods of photographic spectral photometry. Vibration temperatures have been calculated and compared with the available rotation temperature data on these molecules.

Intense cooling of copper and of iron anticathodes changes the character of the X-rays which they emit. Prof. K. Prosad and A. T. Maitra find that the intensity of the copper L_α line is decreased at liquid oxygen temperature. The L-lines shift relatively to one another, and there are indications of changes in width.

Prof. M. Dole suggests a formula for calculating the surface tension of strong electrolytes which gives calculated values in satisfactory agreement with those found experimentally for potassium chloride solutions, including the observed decrease in surface tension at low concentrations. The formula is obtained by postulating a small number of surface locations where negative ions can be adsorbed from the interior of the solution with a large diminution of potential energy.

Two methods for measuring the viscosity of monomolecular films are described by Prof. W. D. Harkins and R. J. Myers : one, in which the film flows through a transverse slit in a barrier confining the film, and another method depending on the vibration of a ring the inner circumference of which is in contact with a pure surface while the outer is in contact with the film. A table giving viscosities of fatty acid films shows that the viscosity increases rapidly with the length of the molecule.

Prof. F. Urban and Dr. M. D. Eaton describe several reactions between lactoflavin, cytochrome *c* and the "complex porphyrin" of Coulter (prepared from diphtheria toxin). The authors infer that the porphyrin ring of cytochrome *c* can oxidize the compounds in Coulter's complex (which are responsible for the absorption bands at 574 mμ and 563 mμ) only when the iron atom of cytochrome *c* is in the divalent (reduced) state, and not when it is in the trivalent state.

The oxidation of the male sex hormone, dehydroandrosterone, by osmic acid to produce the *cis* form of androstanone-triol, by addition of two hydroxyl groups, is described by Prof. M. Ushakov and A. Lutenberg.

Dr. W. A. Waters finds that when benzene-diazonium chloride decomposes in acetone in presence of chalk, benzene and chloroacetone are formed, and if metals such as lead, antimony or mercury are present, these are attacked. The reactions are explained by supposing that free neutral radicals are liberated as the diazo compound decomposes.

From the products of oxidation of β-boswellinic acid (one of the principal constituents of frankincense) Dr. J. C. E. Simpson concludes that the compound is a β-hydroxy-acid.

Research Items

Antiquity of Man in Rhodesia

WITH the view of determining the disputed question of the age of the stone implements of the Zambezi gravels, first described in 1905, the Rhodesian Archæological Expedition of 1929 undertook to investigate the antiquity of man in Rhodesia as demonstrated by the implements occurring in the gravels south of the Falls, their cultural sequence and the relation, if any, of the gravels and their contents to the stages in the recession of the Falls and the excavation of the Zambezi gorge. The results of the archæological investigation have now been reported by Mr. A. Leslie Armstrong and the Rev. Neville Jones, while the necessary geological preliminary considerations are embodied in notes on the geology of the area by H. B. Maufe, director of the Geological Survey of Southern Rhodesia (*J. Roy. Anthrop. Inst.*, **66**, 2). The conclusions are summarized as follows: Over the area examined south of the Falls, the Zambezi formerly flowed over the site of the existing gorge at a level comparable with that of the river to-day north of the Falls, and more than 400 ft. above its present level. The terrace gravel and the old river-bed gravel are true residual Zambezi gravels, deposited when the river flowed over the site of the present gorge. The contained implements of Lower and Middle Palæolithic type are at least as old as the gravels in which they occur. The implements belong to a definite sequence of seven cultural groups from Pre-Chellean to Bambata (Aurignacian). With the exceptions of groups (1) and (7) the cultures represented are South African equivalents of the recognized European series, occurring in the same order of succession, at least as ancient in time, and showing close parallels in type and technique thereto. The Pre-Chellean implements are the earliest recognizable traces of man's occupation of the valley, and antedate the erosion of Gorge 5, the Falls then being to the south. The successive stages in the recession of the Falls and erosion of the Gorge since Pre-Chellean times can be related to the successive stages of culture. Since Pre-Chellean times, two arid and two pluvial periods have supervened. Man in Rhodesia is of an immense antiquity, at least equal to man in Europe.

Colour Changes in Elasmobranch Fishes

THE question of the control of the colour changes that occur in the elasmobranch fishes is a vexed one, and indeed the method may not be the same in different members of the group. Light has been thrown on the subject by G. H. Parker (*Proc. Amer. Phil. Soc.*, March 1937). The animals were anæsthetized by immersion in very cold water, a method that has advantages over anæsthetizing by drugs. The dark phase is induced by a neurohumour produced by the posterior lobe of the pituitary gland. The pale phase in *Raia erinacea* is due to the absence of a dispersing factor and in *Mustelus canis* and *Squalus acanthias* in part to nervous action. The concentrating neurohumour in the last two species is in the nature of a lipohumour soluble in olive oil but not in water, and a stable substance possibly a sterol.

Feeding Mechanism of *Apseudes*

THE Crustacean *Apseudes* is of special interest to the morphologist since it links the Isopoda with the primitive Mysidacea, which are presumed to form the starting point of the Peracaridan series. Very little, however, is known of its habits and mode of life. This deficiency is in part supplied by R. Dennell in a finely illustrated memoir (*Trans. Roy. Soc. Edin.*, **59**, Pt. 1, No. 2, 1937) in which the method of feeding is discussed in relation to the evolution of the feeding mechanisms in the Peracarida. The exact relations of mouth-parts, carapace and associated structures are described in greater detail than has hitherto been done, and the mode of action partly described from observations on the living animal and partly inferred from a study of anatomical relations. It is concluded that the essential features of the primitive Peracaridan filter-feeding mechanisms are represented, but that this method of obtaining food is of little importance and is in process of replacement by raptatory feeding, which is the method followed by most Isopoda. Modifications in the carapace and particularly in the organs concerned in maintaining the respiratory current are adaptations to life in a muddy habitat.

Egg-Killing Washes

IT has been shown that the ovicidal properties of tar oils to *Cheimatobia brumata* L., *Lygus pabulinus* L., *Plesiocoris rugicollis* Fall. and *Psylla mali* Schm. increase with increase in boiling range. Petroleum oils, however, although their general insecticidal properties are known to increase with boiling range, fail to inhibit the hatching of aphis and psyllid eggs, which has led to the suggestion that ovicidal action to such eggs is associated with a chemical toxicity possessed by tar oils but not, in general, by petroleum oils. Moreover, some diversity of evidence exists regarding the relative toxicity of high- and low-boiling tar oils to *Aphis pomi* De Geer. Kearns, Martin and Wilkins (*J. Pom. and Hort. Sci.*, **15**, 1, 56; 1937) have investigated this discordance in an examination of the comparative ovicidal efficiencies of high- and low-boiling oils, the validity of solubility in dimethyl sulphate as a criterion of toxicity and the importance of chemical composition. A wide range of tar and petroleum oils was tested and parallel chemical analyses carried out together with determinations of boiling ranges and solubilities in dimethyl sulphate. Ovicidal efficiency showed no relation to the total content of hydrocarbon oil in the emulsions, but was highly correlated with the content of neutral oils soluble in dimethyl sulphate. The toxicity of oil from which certain oxygenated derivatives were removed by fractionation with hydroferrichloric acid was not significantly different from untreated oil, and an examination of a number of individual compounds for possible toxic properties gave no indication of any specificity of this kind. In the absence of any large differences in the ovicidal properties of high-boiling neutral oils soluble in dimethyl sulphate derived from various sources, the solubility test is regarded as an adequate practical method of assessing the toxicity of hydrocarbon oils to *A. pomi*.

Run-off after Rainstorms

A PAPER by Mr. J. R. Daymond, an abstract of which is published in the *Journal of the Institution of Civil Engineers* (No. 7, 1936–37; June 1937), discusses the estimation of run-off from areas subjected to rainstorms in connexion with a law first proposed by Mr. Emil Kuichling in a paper contributed to the American Society of Civil Engineers (*Trans. Amer. Soc. Civ. Eng.*, **20**; 1889) that "... in drainage areas of moderate size the heaviest discharge always occurs when the rain lasts long enough at its maximum intensity to enable all portions of the area to contribute to the flow. For large areas, on the other hand, a more elaborate analysis becomes necessary in order to find under what conditions the absolute maximum discharge will occur, ..." As the law is often misquoted to the extent of ignoring the provisos and is thus misinterpreted, the object of Mr. Daymond's paper is to show that the reservation regarding large area *is* valid and important. In addition, an important general conclusion is arrived at, applicable to all areas, namely, that provided the rain falls at a *constant intensity, the storm that gives the maximum* run-off is one which lasts for a time less than, or equal to, the time of flow from the farthest point of the drainage area to the point of outfall from the area.

Precursors of a Volcanic Eruption

THE tilting of the flanks of the volcano Asama (Japan) in 1936 is described by R. Takahasi and T. Minakami in a recent *Bulletin* of the Earthquake Research Institute (**15**, 463–491; 1937), while the changes in depth of the crater in 1934–36 are recorded by Minakami (*ibid.*, **15**, 492–496; 1937). Tiltmeters were erected at three stations, 4 km. east, 5 km. north, and 12 km. south-west of the crater. In 1936, explosions were frequent in February–March and July–August, and, during intervals of 7–30 days before then, marked changes of tilt were recorded almost simultaneously at the three stations, the variations being about five times as large as those observed during intervals of quiescence and being clearly independent of changes in air temperature. The tilts were accompanied by remarkable uplifts of the crater floor as a whole. The depths of several points on the floor were determined by triangulation from stations on the crater rim. After a pause of inactivity in July–October 1934, the floor began to rise, the uplift being about 70 m. by the time of the violent explosions on April 20, 1935.

Surface Layers on Glass and Silica

LORD RAYLEIGH (*Proc. Roy. Soc.*, A., **160**, 514) observed that there was always some reflection from the boundary when polished glass surfaces were put *in optical contact. Further investigations* were made by immersing plates of glass or silica in a liquid adjusted to have the same refractive index as the bulk material. The reflection from fire-polished surfaces was found to be very low, but the reflection from surfaces which had been polished was quite appreciable, indicating the existence of a surface film of refractive index different from the bulk material. The refractive index of the film could be determined by finding a liquid mixture which gave minimum reflection. The index rises with the violence of the polishing treatment. In the case of fused quartz ($\mu = 1{\cdot}46$) the index of the surface film could be brought up to 1·6 by polishing. The modified surface film could be removed by hydrofluoric acid. It appears to be in fact a modified form of silica, probably with a depth of about 300 A. Similar but much less marked effects were observed with glasses, and a very small effect with crystalline quartz. Crystalline quartz surfaces can therefore be optically contacted without much reflection at the interface, due to the skin effect. It is shown that most of the reflection observed in this case is due to the distance between the contacted surfaces, which is found to be about seven times the crystal spacing of the silicon atoms.

Built-up Molecular Films

K. B. BLODGETT and I. LANGMUIR (*Phys. Rev.*, **51**, 964) have been able to build up films of various stearates on glass or metal surfaces by dipping the plates through a monomolecular layer of stearic acid spread on water containing salts of barium or other metals. The monolayer is kept under two-dimensional pressure. The first layer attaches itself to the surface by its carboxyl groups as the plate is raised from the water, the second layer attaches with its molecules reversed when the plate is dipped again, and so on. The layer is thus folded back on itself at each dipping. The presence of a little copper facilitates the production of thick films, and films containing 3000 layers have been built. The films are *uniaxial crystals* with the optic axis perpendicular to the surface. The optical properties of the film have been studied and the *ordinary* and *extraordinary* refractive indexes are 1·491 and 1·551 respectively. If a film which has been built up on a barium solution at pH 6·5 is treated with benzene, stearic acid is dissolved out and the resulting skeleton film has a nearly unaltered thickness but a much lower refractive index.

Double Stars and Relativity

IN a paper delivered at the Tercentenary Conference of Arts and Sciences at Harvard on September 4, 1936, Prof. T. Levi-Civita shows that the relativistic equations of motion of two bodies of comparable size can be integrated by treating relativistic effects as perturbations (*Amer. J. Maths.*, **59**, 225; 1937). Two results are obtained, which, it is hoped, may be tested by observation of double stars. The first gives a formula for the angular precession of the periastron of the satellite star. The second is more striking. It predicts that the acceleration of the centre of mass of a double star lies *entirely* in the plane of the relative orbit. This acceleration may be divided into a fluctuating periodic part, and the secular part, the effects of which accumulate during the successive revolutions. The secular acceleration of the centre of mass is directed along the major axis towards the periastron of the principal star. A formula is obtained for the increase of the velocity of the centre of mass during a century, which ought to be detectable eventually by spectroscopic observation. Prof. Levi-Civita has also considered the general case of n bodies (*ibid.*, **59**, 9; 1937), but in this case no definite results capable of observational test have been reached. In a discussion on this paper at Princeton (October 7, 1936), Prof. A. Einstein suggested that an extra term, corresponding to the stresses keeping a body together, was needed in the equations. Prof. Levi-Civita adopted this suggestion, but found that it did not affect the conclusions previously reached.

International Population Congress in Paris

A VERY successful Congress to discuss population problems was held in Paris on July 29–August 1 last, under the presidency of M. Adolphe Landry. The Congress was honoured by the patronage of M. Albert Lebrun, President of the Republic, who attended the opening session. Before this, on July 28, a meeting of the General Assembly of the International Population Union took place; and it may be noted that the Congress was held under the auspices of the Union, which took a definite part in the arrangements for the Congress. At the General Assembly, M. Adolphe Landry was elected president of the Union in succession to Sir Charles Close. M. Landry is a former Minister of State, whose interest in demographic matters is well known. He has written several works on the subject, particularly "La Révolution Démographique" (1934). His management of the Congress was most happy.

During the four working days of the Congress, about 170 papers were presented for reading and discussion. Abstracts of the papers were available at the opening of the Congress, but, as always happens at international meetings of this kind, individual delegates must select their lectures and must necessarily miss some contributions of importance. Some of the papers, particularly the mathematical ones, were difficult to follow at the time, but will be available for study when the proceedings are published. Perhaps the real value of these congresses consists largely in the personal contacts established between workers of different nationalities, who cease to be abstractions to each other and can use the occasion for informal discussions and exchange of views.

The Congress was divided into five sections which were simple and sufficiently comprehensive to cover the whole field. A few of the titles of the lectures will serve to give an idea of the kind of questions which were discussed, thus: "The Calculation of Death-Rates"; "Sur les possibilités de retour à l'équilibre pour une population régressive ou rétrograde"; "A Population Growth-Curve for England and Wales"; "Essai d'établissement d'un indice de densité économique de population"; "Considérations sur la politique démographique d'Auguste et ses effets"; "The Length of Life in the Early Roman Empire"; "Recent Population Movements in the Irish Free State"; "Les types de migrations"; "Die natürliche Bevölkerungsvermehrung Wiens"; "L'évolution sociale de la population italienne à travers les recensements"; "Growth of Urban Population in the United States"; "Fécondité et classe sociale en Suède"; "L'influence du chomage sur la famille"; "Die neue deutsche Bevölkerungsentwicklung"; "Rural Population and Government Policies in the United States"; "Biotypes et fécondité"; "Constitution physique de la jeunesse polonaise".

Now, this is a very mixed bag; but the various aspects of the subject are inter-linked and affect one another. It would be a mistake, for example, to discuss only the statistical side of the population question and to omit consideration of quality. In the same way, an adequate examination of present-day tendencies necessarily involves a study of what has happened in the past; and a discussion of demographic facts in one country is imperfect without reference to what is happening elsewhere.

In view of the considerable range of matter discussed and of the impossibility of being present at more than one section at a time, one can only get a limited, personal impression of the meeting, an impression to be corrected by a study of the proceedings when these are eventually published. Meanwhile, no one can have attended this Congress without having learnt something more about the intricacies of the subject than he knew on arrival. Such papers as that of Prof. Burgdörfer, for example, which dealt chiefly with the effect on the birth-rate of Germany of the new population policy in that country, have an importance for all of us. The abstract of his paper ends with the following sentence: "L'exemple de l'Allemagne prouve que, dans notre civilisation occidentale, il est possible de lutter avec succès contre la baisse du taux de natalité".

Amongst numerous other important contributions to the proceedings may be mentioned the paper by Prof. A. M. Carr-Saunders and Mr. R. S. Walshaw, on "Recent Population Movements in Ireland". The authors remark that, "There is less emigration [from Ireland] than formerly, and it is going to the United Kingdom instead of to the United States. This raises important problems for the United Kingdom, which is faced with the prospect of a declining population. The United Kingdom is still pursuing a policy of giving financial assistance to emigrants going to the Dominions. It is doubtful if this can be continued, and it is a question whether the United Kingdom will not be peopled from Ireland".

RACE AND RACIAL DOCTRINE

ONE section of the International Congress was devoted to matters coming under such heads as biometry, biotypology and heredity. Opportunity was thus afforded for the discussion of a variety of problems connected with the racial question, of which advantage was taken by the Management Committee of the Groupement d'Étude et d'Information "Races et Racisme", an organization which has undertaken the dissemination among the French people of information relating to the fallacies and consequences of the racial doctrines now current in Germany, and is responsible for the publication of the periodical *Races et Racisme* (see p. 458). Arrangements were made for presentation to the Congress of a number of communications dealing with questions bearing upon "race" and their formal discussion. The following account is based upon a report furnished by the organization.

Among those present were the veteran Prof. Franz Boas, who notwithstanding his advanced years had crossed the Atlantic from America for the special purpose of taking part, and Prof. Lips and Prof. Fairchild, also from the United States. A certain 'liveliness' developed in the proceedings owing to the presence of numerous representatives of Germany, among whom were Prof. Rüdin, director of the Kaiser Wilhelm Institute, Prof. Verschuer of the University of Frankfort, and Prof. Hellpach of Heidelberg.

In opposition to views put forward by German delegates on 'purity' of race and 'nordization', Prof. Boas, basing his remarks on the experience of half a century, contended that a definition of race more in accord with realities was an urgent necessity. In even the most inbred populations there were family lines of descent which included different genetic characters, while in every family line were frequently included individuals of most diverse genetic types. There was, he maintained, no population which from the racial point of view was so uniform as to be considered either anatomically or physiologically a unity. The different groups of the white races so far resemble one another that often extremes of the same type are more diverse than the means of two different types. He stressed the influence of environment, and showed how, in the United States, attitude and gesture, which have been said to be determined by race, were modified in the American-born descendants of immigrants.

Prof. J. Brutzkus dealt with the racial bearing of his research on the blood groups of Jews, which he said pointed to a differentiation of four types: Semitic, Western European, Mixed Eastern European and Mongoloid. Further, this differentiation corresponds with the differentiation of head-form. The diversity of Jewish types is due on one side to the crossing of the Semitic type with the proselytes of the Roman Empire, and on the other with those of the Khozar. He maintained that according to the evidence of the blood group the Jews of Berlin are more purely European than the Germans themselves, while the Jews of the Crimea and the Caucasus are more purely Asiatic than the autochthonous Tartars.

The fundamental principle of racial doctrines was attacked by Dr. Zollschan of Prague, who maintained that recent research among the most remote peoples in Europe and the most primitive in other parts of the world had shown that the doctrine of the persistence and immutability of racial type was untenable. The claim to a superiority of racial type was based on the desire to dominate. In conclusion, he suggested a world-wide collaboration of scientific institutions, concentrating on the investigation of the problems of race.

This proposal was strongly condemned by Prof. J. Thurnwald of Berlin, who maintained that no man of science was capable of considering any scientific problem whatsoever without importing into his conclusions elements which were the immutable outcome of his race.

Considerable discussion was also aroused by a communication from Dr. Ritter on the racial composition of the gipsies of Central Europe, in which it was shown that their mixed racial character justified the measures of 'purification' which had been taken by the Third Reich. This contention was opposed by Dr. Brutzkus, who maintained that the "Bohemians" were the most authentic and the purest descendants of the Aryan race.

Debate became particularly lively in discussion of the report on "The Eugenics of Mental Disease", presented by Prof. Rüdin, in which the necessity was urged for the sterilization of all persons known to be affected by hereditary disease. Prof. Schneerson argued in opposition that it had been proved that certain men of genius descended from families subject to hereditary disease, while they themselves were often abnormal, quoting the cases of Dostoiewski and Nietzsche. The doctrine of mental eugenics meant the elimination of outstanding personalities and in the end the lowering of the intellectual standard of humanity. The increase in mental disease, notwithstanding the progress of medical science, was due to the increased nervous tension of modern life, and suggested a remedy in the improvement of material and social conditions. The surest eugenic measure was the instinct of love. Any other detracts from the dignity of man and deprives him of all his faculties of intellectual and moral progress. The proposals of the report were also criticized by Prof. Beck of Prague, who pointed to the contradiction inherent in the application of all racial doctrine and theories of "the blood", which while imputing insubordination to the law of the blood, maintained that a blind racial destiny imposed a determinism, which denied freedom of will to adopt such measures of eugenics as would foster the intellectual advancement of the species—the voluntaryist conception of the problem.

Among other communications may be mentioned Mme. Haiser (Amsterdam) on the effects of environment on the sounds of language, and Dr. Schreider's report on biometric investigations among the Otomi of Mexico. The proceedings of the section closed with a full session devoted to consideration of a masterly report by Mlle. Weinberg on "Differential Biometry and Biotypology in the Classification of Individuals and Groups".

The Central (Native) Medical School, Suva, Fiji

By Sir James Barrett, K.B.E.

THE major problem in the attempt by a civilized nation to develop people who, by our standards, are regarded as backward, is the control of disease and the preservation of health.

It is difficult of solution for several reasons. The native is not inclined to co-operate, as he does not understand—and finds it difficult to understand—the mode of thought and the technique of the European medical officers. The employment of many European medical officers is economically impossible, hence the training of the native himself is essential. Knowing the language, customs and mode of thought of his countrymen, he can effect changes which otherwise would be out of the question. For these reasons the Central (Native) Medical School at Suva, Fiji, furnishes a great object lesson, since it represents a sincere and successful attempt to apply the principles of Western medicine to Polynesians, Melonesians and (now) Indians in the South Pacific. Like most British institutions, the growth has been gradual and the adaptation to needs has been effected as occasion arose.

The Principal Medical Officer in Fiji in 1885—Dr. Coney—obtained the passage of an ordinance providing that any native student who had received hospital training and practice for three years and been examined in medicine and surgery might be enrolled as a native medical practitioner. There was no medical school building and the training was effected at the Colonial Hospital, Suva. In 1900 a lecture room and a hostel for the residence of students were built, and with diagrams, models, text-books and lectures a more comprehensive system was organized. At this date there were about twenty practitioners. In 1918 there were forty-eight, who did fine work in the influenza epidemic of that year, but during which eight of them lost their lives.

In 1923 the hospital was rebuilt and re-organized and called the Colonial War Memorial Hospital, and with subsequent development has become an excellent and extensive institution. Students from other Islands than the Fiji group were admitted and the School became a central school for the Western or Southern Pacific.

At this stage Dr. Montague was Chief Medical Officer, and in co-operation with Dr. Lambert—director of the Rockefeller Foundation in the South Pacific—a notable development took place. A School was built with the generous aid of the Foundation, containing lecture rooms, dissecting rooms, chemical and physiological laboratory, library and museum. Accommodation was provided for forty resident students. Quite recently the Foundation has given an excellent pathological, bacteriological and biochemical block and a post-mortem theatre. It is hoped that this laboratory will become the centre of investigation for scientific study in the South Pacific. The staff of the School consists of a whole-time tutor and fourteen honorary lecturers. The teaching in the old school was in the Fijian language. In the new school good knowledge of English is required of all students, and an entrance examination on the basis of the New Zealand proficiency examination is required. The course of study until 1931 was of three years' duration, but it was then increased to four years' and post-graduate courses came into existence.

Whilst this development has taken place, the training of native nurses was organized on a three-year basis, and in 1935 there were fifty-five nurses in the department and stationed throughout Fiji. It is hoped to make the hospital a central School for Nurses in the South Pacific by similar methods to those adopted in the Central Medical School. Such then is the mechanism of this really useful institution.

The students are divided into two groups—junior and senior. The junior course occupies 1½ years and the senior course 2½ years. The junior course covers chemistry, physics, biology, anatomy and physiology with some voluntary out-patient hospital work. The senior course includes medicine, surgery, public health and the smaller clinical subjects, including the study of diseases of children, diseases of the eye and some dentistry. The number of students in 1935 and their source is set out in the accompanying table:

	1st year	2nd year	3rd year	4th year	Post-graduates	Total
Western Samoa	3	–	–	1	–	4
Eastern Samoa	1	–	–	–	–	1
Tonga	1	–	1	2	–	4
Gilbert and Ellice Islands	1	–	1	2	1	5
Solomon Islands	1	1	1	1	–	4
New Hebrides	–	1	–	–	–	1
Nauru	1	–	–	–	–	1
Cook Islands	2	–	–	1	–	3
Fiji—Fijians	4	–	5	5	1	15
Rotumahans	–	–	2	–	–	2
Indians	1	–	1	–	–	2
	15	2	11	12	2	42

During the year there were 40 students in residence at the two dormitories. The two post-graduates in the above list are qualified native medical practitioners, and do not reside in the students' dormitories. The 12 Fijian students who reside in the smaller dormitory are required to keep their rooms and grounds in good order. The remaining 28 students who live in the large dormitory are expected to keep their own bedroom tidy and clean, but an Indian servant is provided to assist in the general management of the other rooms and the surrounding grounds. The students' dining-room is in the large dormitory, so that during the continuous rainy weather, which lasted for about six months during 1935, the Fijian students were put to great inconvenience as the two dormitories are about a quarter of a mile apart.

Recently Dr. Hoodless, the medical tutor, in answer to some questions of mine, furnished the following information:

Roughly, the 40 students at present (October, 1936) at the Central Medical School, include 19 Polynesians, 6 Melanesians, 6 mixed Polynesian and Melanesian, 7 mixed European and Polynesian and Melanesian, and 2 East Indian. The Polynesian students win most of the prizes at class and yearly examinations, but this is due to their numerical ratio, 19 out of 40 students: and also due to the fact that the mission and Government schools in the Polynesian islands are much superior to those in the Melanesian islands, so that the Polynesian students enter the Medical School with a very satisfactory preliminary education while the pure Melanesian students come here with very little elementary education. Indian students generally speaking are very good at book learning, but they do not make the same success at practical work. For steady regular work and good progress in medical knowledge, the mixed type of student, part Polynesian, is perhaps the most successful of all, but here again there are other factors at work.

Supervision of the students when they return to their own Islands is entirely in the hands of the local administrations. For Tonga, the Gilbert and Ellice Islands, and the Solomons, the native medical practitioner ordinances in each Administration can be controlled from Fiji through the Western Pacific High Commissioner, who is also Governor of Fiji. For Eastern Samoa (U.S.A.), Western Samoa (N.Z.), Cook Islands (N.Z.) and the New Hebrides (Fr. and Brit.) the position is different. The success of the native medical practitioner system in each of these Administrations depends on: (*a*) A sympathetic understanding and control from the Administration concerned. (*b*) A close personal and very sympathetic understanding from the European medical officers in any of these Administrations in regard to the *native* medical practitioners sent back from Suva to that Administration. (*c*) A continuously developing *esprit de corps* among all the qualified native medical practitioners far and wide in the South Sea Islands. This is obtained through the *N.M.P. Journal*, personal correspondence, and occasional post-graduate courses.

Pensions have been granted for retired native medical practitioners in Fiji only. The native medical service is only a few years old in the other Administrations, and the question of retirement on pension has not yet arisen, nor is it likely to arise for another fifteen years or more. It is anticipated that pensions will be granted in Tonga and in Western

Samoa, but in the other Administrations it is probable that increased salary and allowances will be given during the actual period of service and that no pensions will be granted.

The native medical practitioners receive salaries varying from £60 to £150 per annum, which apparently meet their wants adequately. They are medical officers and do not seek private practice as we understand it. Their journal, *The Native Medical Practitioner*, is an excellent publication which will interest any European practitioner.

In the *Tropical Diseases Bulletin* of November 1936 a detailed account of the working of the Central School is published by Dr. Clunie (Medical Superintendent of the Colonial War Memorial Hospital, Suva) and Dr. McGusty (late Inspecting Medical Officer, Fiji). The Islands served contain about 500,000 people, and at present there are 84 medical practitioners distributed as follows: Fiji 56, Samoa (Western) 9, Samoa (Eastern) 0, Tonga 4, Cook Island 2, Gilbert and Ellice 10, Solomon Islands 2, New Hebrides 1, total 84; native obstetric nurses, Fiji, 47.

Their conclusion is as follows: "Taken individually the Administrations participating in the Native Medical Practitioner scheme have not the means to embark on elaborate enterprises to provide adequate medical services, but by a pooling of their resources, as is now the case at the Central Medical School, it is felt that they will be able to elaborate a common form of health organization that will bestow further benefits on the native peoples. In Fiji the system has proved successful after a long and searching trial, and if it is too early yet to claim the same success with regard to its more recent ramifications into the other Pacific Administrations, the similarity of conditions and the favourable reports that are coming to hand appear to provide full justification for the confidence which those of us who are in the closest touch feel with regard to the future of the Native Medical Practitioner in the Pacific. As the system becomes more permanently established everywhere it will suffer progressively less from the effects of destructive criticism, but there will always remain the danger that some over-enthusiastic supporters may lose sight of the fundamental cause of its success and in a misguided attempt to raise the status of the Native Medical Practitioner may defeat the purpose for which the school was created, namely to make a health service available to these native peoples at a low cost and in the form that is most easily assimilable by their society."

The School is administered economically, the average cost per student being about £75 per annum; that is, total cost about £3,000 per annum. Amongst the many tributes to the efficiency of the School place must be given to the observation of Prof. Buckmaster and Dr. Wright made after a visit to the School when returning to England in 1931 from Australasia. Their comment was as follows: "The Hospital and Medical School at Suva for Natives of Fiji, Samoa and Other Islands is really a wonderful place to find in the South Pacific. We not only saw all over the Hospital, but conducted a short class in anatomy and physiology in the School and both thought the students equal to what we might have expected to find in an ordinary Medical School in London. Indeed we were both astonished at the information they had acquired. I ask how many Englishmen know anything about this remarkable Hospital in Fiji?"

In conclusion I have one caution to emphasize. If enthusiastic people try to extend the course and to increase the expense, much damage may be done in seeking something economically impossible. There is, I am glad to say, no evidence at present of any such intention. Depopulation has ceased in Fiji and with prudent administration the Central School may prevent depopulation in the other Islands. I am very grateful to Dr. A. H. B. Pearce, Principal Medical Officer, Fiji, and his staff for the information furnished on several visits, for the personal contact obtained with these fine young men and for many reports.

The Radio Exhibition at Olympia

THE annual radio exhibition at Olympia, which this year was held on August 25–September 4, is generally a partial disappointment to those interested in the scientific and technical aspects of broadcasting, as it is usually quite difficult to ascertain what technical progress and improvements are being displayed. The exhibition is largely an elaborate display of the external cabinets, although most firms nowadays provide simple means for inspecting the internal construction and layout of the receiver itself. This year there was abundant evidence to show that most manufacturers have realized that the modern broadcast receiver has to take its place as an article of domestic furniture, and as such it must not be made especially conspicuous by its curious shape and appearance. Another notable advance in what may be termed the external features of the receiver is constituted by the enlargement of the tuning scale and its ease of operation. There is, however, still room for greater uniformity in the location of the control knobs among receivers of different makes.

In order to appreciate the improvements made in the internal portion of broadcast receivers, the visitor to the exhibition was fortunate in having as a guide the detailed reports given by such technical journals as the *Wireless World*, which has published three special show numbers on this occasion. A general survey of this year's exhibits of the various manufacturers indicates that many fundamental features of the broadcast receiver have become sufficiently stabilized for the designer to concentrate upon the steady improvement of detail. The great majority of receivers now manufactured are of the supersonic heterodyne type, since this provides both the sensitivity and the selectivity required by modern broadcasting conditions. The selectivity has now generally been made adequate by the incorporation of a properly tuned amplifying stage operating at the incoming signal frequency. A noteworthy advance this year is the incorporation of a correctly designed short-wave range as a standard feature; and the division of the short-wave broadcasting band into two ranges is a factor which adds considerably to the ease of operation of the receivers so fitted. Those familiar with difficulties of tuning in short-wave stations will also appreciate the improvements in the mechanical portion of the slow-motion drive to the tuning condensers, as well as the large easily read scale which is generally provided nowadays. Several of the receivers shown at the exhibition were provided with a wave-length range in the ultra-short wave band, so that they may be used for the reception of the sound portion of the television programmes.

This year's exhibition was not so conspicuous as some of the previous ones for radical modifications in the types of valves incorporated in receivers, but two points here are worthy of note. The development of the tetrode output valve has caused the rating of most mains-operated receivers to be raised from the previous value of 2–3 watts to 5 watts or above. Secondly, one manufacturer of an all-wave supersonic-heterodyne receiver is experimenting with the use of the Harries all-stage valve. In this receiver all six valves are of the same seven-electrode type, the valves being adapted for their functions in the various stages by suitable external connexion to the electrodes. It will be interesting to observe the results of this innovation, since the advantages of using the same type of valve in any position in a receiver are self-evident.

In the case of battery-operated sets, the main problem all the time is to obtain sufficient output of good quality without overloading the normal high-tension battery, the size of which has now become fairly well standardized. Although the output from such receivers seldom exceeds half a watt nowadays, considerable improvement in acoustic sensitivity has been attained by the use of improved magnetic alloys for the small permanent magnet loud-speakers generally employed in such sets. There is ample evidence that the portable wireless receiver has still a wide field of service, and the attractions of several of this year's models are enhanced by the inclusion of a properly designed short-wave range.

Probably the most interesting feature of Radiolympia this year, from a technical point of view, was the fact that more than a dozen manufacturers showed fully developed television receivers suitable for the programmes now regularly provided from the London station. Direct reception of these programmes was carried out at the exhibition, and facilities were provided for each firm to give demonstrations to the public under comfortable viewing conditions. So far, little uniformity is noticeable in the design of the television receivers produced by the different manufacturers, although they naturally all employ the cathode ray tube for the reproduction of the picture image. There is a tendency to favour the use of the supersonic heterodyne receiver, although in a number of sets the amplification is carried out at the ultra-high frequency employed for the television service. There is as yet no uniformity in the methods employed for the control of the electron beam in the cathode ray tube, as both magnetic and electric methods are employed for focusing and deflection. One of the most interesting television receivers exhibited employs a tube of only 4 inches diameter; the image produced on the fluorescent screen of this tube is projected on to an etched glass screen giving a picture of size 20 in. × 16 in. The more normal method, however, is to produce the final picture on the screen of the cathode ray tube and to view this either directly or through an inclined mirror. The normal size of picture for receivers priced at 60 guineas upwards is about 10 in. × 8 in.; but some cheaper receivers are now available giving a picture size of about 7½ in. × 6 in. With the view of obtaining the utmost economy in the production of a television receiver, one type shown provides the circuits for the vision signal only, a normal broadcast receiver being required in addition to reproduce the sound accompaniment. In this way, a receiver giving a picture about 6 in. × 4½ in. in size can be obtained for about £35. This is a development likely to be worth exploring in the attempt to produce a television receiver at a price sufficiently low to appeal to a large number of listeners who already possess a normal broadcasting receiver.

In concluding this review of the exhibition organized by the Radio Manufacturers Association, mention must be made of the interesting museum provided to illustrate the evolution of the modern broadcasting receiver, and of the extension to the television field of the interesting demonstrations provided by the Post Office to illustrate the deleterious effect of various classes of electrical interference on the conditions of broadcast reception. Finally, it must not be forgotten that one of the most popular attractions of Radiolympia is the provision by the British Broadcasting Corporation of daily variety concerts in a specially constructed hall, which this year contained accommodation for an audience of more than 5,000.

R. L. S.-R.

Isotopes of Strontium

WORK on the isotopes of strontium has recently been reported by Mattauch, and by Hahn and co-workers. Mattauch (*Naturwiss.*, 25, 170; 1937) has determined the packing fractions of the isotopes ^{86}Sr and ^{87}Sr by the doublet method, using $^{29}SiF_3$ and $^{30}SiF_3$, respectively, for comparison. Using the data of other workers for the masses of ^{29}Si and ^{30}Si, the packing fraction of ^{87}Sr is found to be − 8·7 ± 0·3, and its mass $86{\cdot}924_8$ ± 0·004. The packing fraction of ^{86}Sr is − 9·0 ± 0·5, and its mass $85{\cdot}922_6$ ± 0·004.

The radioactive transformation of rubidium into the strontium isotope of mass 87 has been investigated by Hahn, Strassmann and Walling (*Naturwiss.*, 25, 189; 1937), who examined the strontium occurring in a mica from Silver-leaf mine, Manitoba. The mica was comparatively rich in rubidium (containing 2–3 per cent of it), but contained only a very minute amount (a few hundredths of a per cent) of alkali earth metals. Careful treatment of the mineral resulted in the isolation of 250 mgm. of strontium carbonate. If rubidium breaks down by radioactive disintegration to give strontium, it would be expected that the product of disintegration would be present in the mineral in comparatively small amount. As alkali earth metals were actually almost entirely absent, it is very likely that the small quantity of strontium present was derived from this disintegration. The geological age of the mica is estimated at

500–1,000 million years, whilst the half-life period of rubidium is between 2×10^{11} and 4×10^{11} years.

An investigation of the isotopic constitution of the strontium from the mineral throws much light on its origin. This has been carried out by Mattauch (*Naturwiss.*, **25**, 189; 1937), who finds the strontium to contain 99·97 per cent of the isotope of strontium of mass 87. It is therefore very probable that the β-radioactive disintegration of ^{87}Rb results in the formation of ^{87}Sr. This is in agreement with the rule that stable isobares of neighbouring elements do not exist. A rough estimate of the quantity of strontium produced during the life of the mica shows that the half-life period of radioactive rubidium is more nearly 2×10^{11} years than the upper limit mentioned above.

University Events

CAPE TOWN.—Prof. A. W. Falconer has been appointed to succeed Sir Carruthers Beattie as principal and vice-chancellor of the University. Sir Carruthers Beattie will retire at the end of the year. Prof. Falconer is at present professor of medicine in the University.

CAMBRIDGE.—T. R. C. Fox, of Jesus College, and J. Diamond, of St. John's College, have been appointed demonstrators in engineering.

Dr. R. A. Lyttleton and M. H. L. Price have been appointed Faculty assistant lecturers in mathematics.

J. Hart-Mercer has been elected to the Gwynaeth Pretty studentship and to the Nita King scholarship.

At St. John's College, a Strathcona exhibition for physics has been awarded to R. E. B. Makinson, University of Sydney, and a Hutchinson studentship for zoology to J. H. Sang, University of Aberdeen.

Science News a Century Ago

J. D. Forbes among the Dolomites

IN the course of his Continental tour of 1837, J. D. Forbes after leaving southern Germany explored the Tyrol and early in September entered the then little-known 'Dolomite' country, proceeding in the direction of the peak of Marmolata. In his journal, under the date September 14, he said: "This morning, whilst warming myself dreamily during the rain at the kitchen fire at Cavalese, I got an excellent geological lesson from the boiling of certain thin porridge made of Indian corn (polenta) and milk. The air-bubbles disengaged during the process formed the most beautiful elevation craters, often with little interior ones, formed by the immediate sequence of another bubble at the same point. . . . I walked from Cavalese to Vigo, in order to understand fully Von Buch's section of the adjacent beds of rock, and in this I succeeded beyond my expectations. But the strata of limestone and sandstone do not all dip towards the axis, as he has represented, but some from it, and with evident disturbance. I went in search of minerals to a dealer's, but only found some very indifferent specimens.

"The scenery from Vigo to Campedello, and from that to Canazea, is in the highest degree striking—in fact, I know nothing of its kind to compare with it: one is entirely surrounded by jagged peaks of dolomite. The amazing crags of the Lang Kofel come into view near Campedello, and afterwards the magnificent outworks of the Marmolata and Sasso di Val Fredda are seen in all their majestic beauty. As I wished to examine the Lang Kofel more minutely, as well as Von Buch's sections between Gröden and Colfusco in the Abteier-Thal, I availed myself of a tolerable horse track which wound through the forest, and after passing close under the precipices of the Lang Kofel, entered the Grödener-Thal. . . ."

Prof. William Ritchie, F.R.S.

ON September 15, 1837, William Ritchie, the professor of natural philosophy at the Royal Institution and also in University College, London, died at the age of forty-seven years. Born in Scotland in 1790, he was educated for the ministry and became Rector of the Royal Academy of Tain, Ross-shire. Having saved money he went to Paris, where he attended the lectures of Thénard, Gay-Lussac and Biot and on his return to England became known to Sir John Herschel. Papers he contributed to the Royal Society on a differential thermometer and radiant heat brought him into notice, and in 1829 he was given the professorship at the Royal Institution and in 1832 that at University College. He published papers in the *Philosophical Magazine* and other periodicals and made researches in electricity and electric magnetism. He was also known as a skilful experimentalist, and at one time was engaged on experiments connected with the manufacture of glass for optical purposes.

Animal Magnetism

THE *Gentleman's Magazine* of September 1837 gives the following information: "At the North London Hospital, M. Duportet, the French professor of animal magnetism, lately performed some experiments before a party. He commenced his operations on a young girl, about 17 years old, an inmate of the hospital, who has been ill for some time, but who is at present almost convalescent. She was seated in a chair in the middle of one of the wards, and M. Duportet seated opposite to her commenced the operation of magnetizing, which is done by waving the hand up and down in a perpendicular line before the face and body, as closely as possible without almost actual contact. After these motions of the hand had been continued for some minutes without effect, the professor, nothing disconcerted, left off, and another patient was introduced, who, we understood, had been operated upon more than once, deriving, it is stated, some benefit in her health. She was a young woman named Lucy Clarke, who having for some time past been subject to epileptic fits, had been induced to come to the hospital from Tottenham, where she resided, that the experiment might be made upon her. As soon as she was seated Prof. Duportet commenced the wafting of his hands, and in a few seconds an appearance of extreme drowsiness became evident to all who stood around his chair, and she frequently rubbed her eyes as children do when sleepy. She at length ceased to have the power of opening her eyes. The magnetizer, however, who had placed her under the spell, had the power also of restoring her to a state of wakefulness. This he did by placing his fingers on the centre of the forehead and drawing them asunder towards the temples, and afterwards waving the hand to and fro before her face."

Cholera in Europe

An editorial in the *Lancet* of September 23, 1837, gives the following account of a pandemic of cholera at that time: "The cholera—that terrible epidemic, which after having exercised its ravages in all parts of the old and new world, seemed on the point of returning to the country which gave it birth, has again appeared raging with unabated violence not only in many of the southern States of Europe, but in some of the northern kingdoms, already more than once visited by the pestilence. Our readers are doubtless aware that the Asiatic cholera has been stalking along the Mediterranean shores of Europe for the last two or three years, and that, at the time we write, it has reached the capital of the Papal dominions. The progress of the disease through countries, the inhabitants of which are forcibly kept by their rulers in a state of ignorance, has been almost universally accompanied by disorder of the most serious nature.

"At Palermo the Governor has fallen a victim to the fury of a terrified and excited populace; and at Rome, if we are to believe the reports which have just reached us, the medical men are everywhere compelled to conceal themselves in order to avoid sharing the fate of several of their brethren, who are massacred during the period of excitement and consternation, which are produced at the onset of the malady. Marseille also has been attacked, for the third time, by the epidemic, which during several days carried off nearly 100 persons daily, and we are sorry to announce that the disease is spreading rapidly throughout the department of which that city forms the capital".

Societies and Academies

Paris

Academy of Sciences, July 5 (*C.R.*, **205**, 1–96).

Wolfgang Dœblin: The elements of a general theory of the simple constant chains of Markoff.

Kentaro Yano: Totally geodesic non-holonome spaces.

Marcel Brelot: The best harmonic majorant of a sub-harmonic function.

Raphaël Salem: A method of summation nearly always valid for Fourier's series of continuous functions.

Natan Aronszajn: A theorem of the theory of analytical functions of several complex variables.

Jean Leray and **Louis Robin**: Complement to the study of the movement of an unlimited viscous liquid.

Pierre Vernotte: Navier's equations and the dissipation function, in a hydraulic system. The thermal phenomena produced in the fluid by a rapid movement.

Max Teissie Solier, **Luis Castagnetto** and **Marcel Sabathe**: The beats which accompany the formation of the alternate vortices of Bénard Karmann.

André Lichnerowicz: Extension of the Gauss-Whittaker theorem.

Fritz London: The quantum theory of the diamagnetism of aromatic compounds.

Th. De Donder and **J. Géhéniau**: The electronic model of Dirac's wave mechanics.

Jean Jaffray: Observation of the stratified Geissler discharge in different gases at atmospheric pressure. Under certain conditions, described in detail, stratification can be seen and photographed in Geissler tubes containing various gases at nearly atmospheric pressure.

Frantz Perrier: The action of an electric field on an electrified insulator placed in air: the ionization of the latter.

Alexandre Dauvillier: A universal counter. A modification of the Geiger-Müller counter, utilizing Richter and Geffcken relays with Neher and Harper mounting. The working voltage can be reduced to 300 volts, and the arrangement is suitable for measuring the intensity of the cosmic rays with captive balloons.

Georges Ahier: Christiansen filters. These filters are cells containing a transparent powder mixed with a liquid of the same refractive index. Study of the results obtained by varying the solid (flint and crown glass, fused silica, fluorspar) and the liquid.

Casimir Jausseran, **Léon Grillet** and **Michel Duffieux**: The fine structure of the 5998·9 band of nitric oxide.

Bertrand Goldschmidt: Study of the fractionation coefficients of salts possessing several hydrates. Study of the crystallization of barium acetate, with actinium X as indicator, and of strontium nitrate in presence of a trace of lead nitrate, with thorium B as indicator.

Jean Perreu: The equation of solubility of a pure substance forming a solid compound with the solvent. Control of a differential equation obtained theoretically by an experimental study of the system sodium iodide and acetone.

Martial Félix Taboury and **Marcel Bellot**: The action of light on the Liesegang phenomenon.

Haldun N. Terem: The oxidation of beryllium bronzes.

Eugène Cattelain and **Pierre Chabrier**: Contribution to the separation of the phosphoric ion and its estimation by a volumetric method.

Jean Baron and **Paul Laffitte**: The inflammation of acetaldehyde. Determinations of the temperatures of spontaneous inflammation of various ternary mixtures of acetaldehyde and oxygen with nitrogen, argon or carbon dioxide as diluent.

Marc Tiffeneau, **Paul Weill** and **Bianca Tchoubar**: The isomerization of cyclohexane methylene oxide into hexahydrobenzaldehyde, and the conversion of the corresponding amino-alcohol into cycloheptanone.

Marcel Sommelet: A particular mode of intramolecular rearrangement. Study of the decomposition by heat of $(C_6H_5)_2CH\text{-}N(CH_3)_3OH$.

Werner Lipschitz and **Ernst Büding**: The *d*- and *l*-borneolglucosides.

Panos Grammaticakis: Some modes of hydrolysis of the substituted N-benzaldoximes.

Jean Kandel: The hydrocarbons, halogen derivatives, ethers and esters corresponding to tetrahydroionol.

Joseph Hoch: Contribution to the study of substances with female hormone properties. The synthesis of 2-oxo-6,7,8,9-tetrahydro-4,5-benzoacenaphthene.

André Guillemonat: The oxidation by selenious oxide of cyclohexene and of the 3 and 4 nonenes.

Raymond Hocart: The structural scheme of proustite and pyrargyrite.

André Vatan: The comparative mineralogy of the sandy sediments of the Paris basin.

J. Gourc and **Franck Bourdier**: Pollen analysis and stratigraphical position of the Quaternary lignites of the Chambéry region.

Théodore Monod : The geological constitution of the Mauritanian Adrar.

Alexandre Guillerd and Pierre Etrillard : The persistance of fluorescin in the soil. The influence of ferruginous formations.

Nicolas Stoyko : The periodicity in the irregularity of the rotation of the earth.

Arthur Brunel and Robert Echevin : The evolution of nitrogen, appearance of allantoinase and of urease in the germination of rust (*Agrostemma Githago*).

Joseph Lefèvre : The reversal of polarity produced in cuttings of *Salix*.

A. Guieysse-Pellissier : The presence of striated muscular fibre in the pulmonary arteries of the rat and the mouse.

Maurice Villaret, Henri Bénard, Louis Justin Besançon and Mlle Andrée Abadi : The mathematical study of the kinetics of hæmolysis (kinelysis).

Léon Képinov : The antiglycogenolytic action of insulin.

René Salgues : Nutrient leucocytosis in reptiles in bad conditions of captivity.

Jean Loiseleur : The adsorption of polypeptides by proteins. The behaviour of a solution of peptone.

Forthcoming Event

Faraday Society, September 13–15.—General discussion on "Reaction Kinetics" to be held in the University of Manchester.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned :

Assistant Lecturer and a Demonstrator in Electrical Engineering in the Imperial College of Science and Technology (City and Guilds College), Prince Consort Road, S.W.7—Secretary (September 13).

Assistant Lecturer in Electrical Engineering in the Manchester Municipal College of Technology—The Registrar (September 20).

Lecturer in Physical Chemistry (Grade II) in the University of Bristol—Secretary and Registrar (September 24).

Soil Chemist for the Rubber Research Scheme, Agalawatta, Ceylon—The Chairman (November 15).

Inspectors of Mines in the Colonial Mines Service—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1.

Official Publications Received

Great Britain and Ireland

Forestry Commission. Special Leaflet No. 1 : Pit-Props. Pp. 8. (London : Forestry Commission.) [178

Iron and Steel Institute. Special Report No. 18 : Reports upon Blast-Furnace Field Tests. 1 : An Investigation of a Blast-Furnace smelting principally Lincolnshire Ores at the Frodingham Works of the Appleby-Frodingham Steel Co. Ltd. Pp. v+98. 10s. Special Report No. 19 : Foamed Blast-Furnace Slag. By Dr. T. W. Parker. Pp. v+32. 5s. (London : Iron and Steel Institute.) [208

Forestry Commission. Bulletin No. 14 : Forestry Practice ; a Summary of Methods of Establishing Forest Nurseries and Plantations with Advice on other Forestry Questions for Owners and Agents. Revised edition. Pp. 99. (London : H.M. Stationery Office.) 1s. 6d. net. [238

The Journal of the Institute of Metals. Vol. 60. Edited by G. Shaw Scott. Pp. 456+59 plates. (London : Institute of Metals.) [238

Air Ministry : Meteorological Office. Southport Auxiliary Observatory (the Fernley Observatory of the Corporation of Southport). Annual Report, and Results of Meteorological Observations, for the Year 1936. By Alfred Goodwill. Pp. 32. (Southport : Fernley Observatory ; London : Air Ministry.) [238

Air Ministry : Aeronautical Research Committee : Reports and Memoranda. No. 1760 (2458 and 2459) : Progress of Experiments in Aero-Engine Exhaust Silencing. By A. W. Morley. Pp. 18. 2s. 6d. net. No. 1761 (2362) : The Stress in Certain Tubes of Rectangular Cross Section under Torque. By D. Williams. Pp. 34. 4s. 6d. net. No. 1766 (2607) : Experiments on a Sphere at Critical Reynolds Numbers. By A. Fage. Pp. 20. 3s. net. No. 1771 (2722) : Tests of Four Airscrew Sections in the Compressed Air Tunnel. By D. H. Williams, A. F. Brown and E. Smyth. Pp. 20. 3s. net. No. 1774 (2675) : Aerodynamic Characteristics of Tapered Wings with Flaps and Slots. By Dr. S. H. Hollingdale. Pp. 43. 6s. net. No. 1779 (2693) : Experiments on the Use of a Static Tube in the Wing Wake and a Short Pitot Tube in the Leading Edge as an Airspeed Indicator. By the Aerodynamics Staff, R.A.E. Pp. 6. 1s. net. (London : H.M. Stationery Office.) [258

Other Countries

Government Museum, Trivandrum. Administration Report for the Year 1111 M.E. Pp. 8. A concise Guide for Visitors. Pp. 8. (Trivandrum : Government Museum.) [188

U.S. Treasury Department : Coast Guard. Bulletin No. 19 : The Marion and General Green Expeditions to Davis Strait and Labrador Sea under direction of the United States Coast Guard 1928–1931–1933–1934–1935. Scientific Results, Part 2 : Physical Oceanography. Pp. vi+259. (Washington, D.C. : Government Printing Office.) 75 cents. [188

Report of the Kodaikanal Observatory for the Year 1936. Pp. 4. (Delhi : Manager of Publications.) 3 annas ; 4d. [198

Madras Fisheries Department. Administration Report for the Year 1935–36. By Dr. B. Sundara Raj. Pp. iii+68+3. (Madras : Government Press.) 8 annas. [198

Meteorological Office. Note No. 17 : Climatic Notes—New Zealand Districts. By Dr. E. Kidson. Pp. 32. (Wellington : Government Printer.) [238

Statens Meteorologisk-Hydrografiska Anstalt. Tillgör Årsbok 18, 1936. Årsberättelse för 1936. Pp. 19. Årsbok 18, 1936. 1. Månadsöversikt över väderlek och vattentillgång. Pp. 76. 2.50 kr. (11s.) Nederbörden i Sverige. Pp. 15. 2.50 kr. (Stockholm : Staten Meteorologisk-Hydrografiska Anstalt.) [238

Anales del Museo Argentino de Ciencias naturales. Antropologia, Etnologia y Arqueologia, Publicación No. 78 : Fuéguidos y Láguidos, posición actual de la raza Paleo-americana o de Lagoa Santa. Por J. Imbelloni. Pp. 79–104. Publicación No. 79 : Deformación del cráneo en la región de los Atacamenos y Diaguitas. Por el Prof. Ricardo E. Latcham. Pp. 105–124. (Buenos Aires : Museo Argentino de Ciencias naturales.) [238

Report of the Botanical Survey of India for 1935–36. Pp. 11. (Calcutta : Government of India Press.) [238

Commonwealth of Australia : Council for Scientific and Industrial Research. Bulletin No. 105 : Investigations on the Associated Growth of Herbage Plants. By H. C. Trumble, T. H. Strong and R. E. Shapter. Pp. 40+10 plates. Bulletin No. 106 : Investigations on "Spotted Wilt" of Tomatoes. 3 : Infection in Field Plots. By Dr. J. G. Bald. Pp. 32. (Melbourne : Government Printer.) [238

U.S. Department of the Interior : Office of Education. Bulletin, 1937, No. 2 : Trends in Secondary Education. Pp. vi+44. 10 cents. Pamphlet No. 71 : An Annotated Bibliography on the Education and Psychology of Exceptional Children. Prepared by Elise H. Martens and Florence E. Reynolds. Pp. iii+42. 10 cents. (Washington, D.C. : Government Printing Office.) [238

Classified List of Smithsonian Publications available for Distribution, August 10, 1937. (Publication 3394.) Pp. vi+35. (Washington, D.C. : Smithsonian Institution.) [238

Smithsonian Miscellaneous Collections. Vol. 96, No. 1 : Archeology of St. Lawrence Island, Alaska. By Henry B. Collins, Jr. (Publication 3411). Pp. xi+431+84 plates. (Washington, D.C. : Smithsonian Institution.) [238

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Philosophy of Early Education

IT was a foregone conclusion that so original and stimulating a contributor to contemporary thought as Mr. H. G. Wells—on this occasion we are almost invited to dub him Dr. H. G. Wells—would have things to say to Section L (Education) of the British Association calculated to provoke lively interest and discussion. Few listeners to his presidential address, many of whom were working teachers, could have adopted the language of Tennyson's "Northern Farmer": "An' I thowt a said whot a owt to 'a said, an' I coom'd awaäy". The address was probably the better for being plain-spoken and provocative, for only so could Mr. Wells have been at his characteristic best.

Notwithstanding certain of his earlier experiences, Mr. Wells disclaimed the right to appear before his audience as a teacher, but preferred to introduce himself as a citizen at large. We take this to mean, what is indeed sufficiently obvious, that he is no expert in the art of teaching a class and managing a school, but that he claims the right of every intelligent citizen to criticize the results of the teaching and the output of the schools. Mr. Wells, however, *is* something more than a distinguished outsider. In his later phase at least, his writings have been those of a public teacher, who definitely sets out to show what young people ought to learn, if they are to become efficient citizens in the world of to-day. In other words, though he makes only a limited claim to talk about methods of teaching, he makes, rightly as we believe, an emphatic claim to talk about the content of teaching, the mental fare which the schools provide for potential citizens. His now famous "Outline of History", followed by the companion outline of "The Science of Life"—both of them necessarily written with much collaboration—indicated his general view as to the kind of thing which an educated person ought to know. An acquaintance with the fifteenth chapter of his later book, "The Work, Wealth and Happiness of Mankind", further prepared one for the opinions to which he has now given full and forcible expression.

Mr. Wells began and ended his discourse with an almost solemn warning as to his self-imposed limitations. Questions of "drill, skills, art, music, the teaching of languages, mathematics and other symbols, physical training and development, and the rest", he deliberately placed outside the scope of his message. He felt he could be most helpful by concentrating on the sort of world picture we are presenting to young people, the essential framework of knowledge that should be established betimes in the normal citizen of our modern community. Whether he was fundamentally right in making all these exclusions from the essential framework is bound to be a sharply controversial topic, upon which we cannot fully enter. Suffice it to say that, according to Mr. Wells's judgment of educational values, the indispensable and irreplaceable structure of *fact*, the main beams and girders of which structure must be laid down, soundly or unsoundly, before the close of adolescence, should rest upon a threefold foundation of history, biology and geography, widely interpreted. These three, says Mr. Wells in effect, are the things that abide, and it is probably safe to add that in his view the greatest of these is history. But merely to quote these familiar labels would be to convey a totally inadequate idea of the length and breadth of his message.

What Mr. Wells means by history was already familiar to many, we hope to most, of his listeners. But he took the opportunity of denouncing once more the sort of history which, at any rate until recently, has been taught in our schools, and in great measure accounts for that "crazy combative patriotism" which now threatens to destroy our civilization. Equally mischievous, he added, is the "furtive anti-patriotism of the leftish teacher". We suggest, however, that if Mr. Wells thinks that the sort of history denounced long ago by Herbert Spencer as "an obituary of kings and queens" and denounced later by John Richard Green as "drum-and-trumpet history", is still encouraged in our schools, he ought to make further inquiries. But the rest of his indictment is not so easily disposed of. He demands that school history should not only shed its insularity, its narrow nationalism and its contempt for the lesser breeds without the law, but that it should also be nothing less than the story of man's great adventure upon this planet. He claims that the archæologists, and the historians of the rise and fall of empires, have provided far finer material for the mental equipment of modern youth than the 'hole-and-corner' history of a single nation. Here he will have many sympathizers and some severe critics. It was to be expected that this part of his address would receive special comment in the daily Press.

As regards the rest of the informative content of the curriculum as conceived by Mr. Wells, there will be general agreement with his ideas about the teaching of geography and simple economics; and indeed the modern teacher in schools of every kind has already gone a long way towards satisfying his requirements. The chanting of lists of capes and rivers is mostly a thing of the past. Where geography passes over into biology his strictures are just. Too many young people leave school ignorant of the wonderful story of life upon the earth, and equally ignorant of the working of their own bodies. But, asks Mr. Wells in effect, who is sufficient for these things? Certainly not, he declares, the present generation of teachers, two-thirds of whom ought to be reconditioned or superannuated. Here again, having regard to the work done in summer schools and refresher courses, and the activities and publications of such large and important professional bodies as the Science Masters' Association and the Geographical Association, Mr. Wells should have made further inquiries. Also even a cursory examination of the text-books or reading-books now available for pupils of all ages, and exhibited by publishers at such meetings as those of the Annual Conference of Educational Associations, would have shown him that the school books of to-day are vastly superior in every respect to those of the past.

The present position is that teachers as a body are more mentally alert and educationally active than ever they were. True, they may not be sufficiently intent upon the informative components of the curriculum as advocated by Mr. Wells, but their general attitude suggests plenty of room for hope. A generation ago, teachers were too much occupied in fighting for reasonable conditions of service. To a great extent they are now occupied in fighting for a better chance for the pupils.

But we wish to close these comments upon a note of appreciation. In one of his charming and vigorous philosophical essays, William James took up strongly the position that the great philosophic thinkers, however much they might try to sink the fact of temperament, could never succeed in doing so. The philosopher's temperament, declared James, "really gives him a stronger bias than any of his more strictly objective premises. It loads the evidence for him one way or the other, making for a more sentimental or a more hard-headed view of the universe". James proceeded to a broad classification of the great philosophic thinkers as the tender-minded and the tough-minded. The tender-minded he described as rationalistic (devoted to abstract and eternal principles), idealistic, optimistic, religious, free-willist and dogmatic. The tough-minded he described as empiricist (devoted to facts in all their crude variety), materialistic, pessimistic, irreligious, fatalistic and sceptical.

Not for one moment would we wish to apply to Mr. Wells every item in the second of these lists of adjectives. But he is one of the outstanding public teachers of our time, accustomed to take the broad philosophic outlook upon every problem that he touches; and if we were asked in which of the two categories we would place him, we should inevitably place him among the tough-minded. Few of our prominent thinkers could, for example, have got to the end of *any* sort of discourse on education without ever mentioning Shakespeare; but Mr. Wells forgot even to mention literature among the skills, etc., which he designedly excluded from his survey. Perhaps the British Association will next year seek to restore the balance by inviting one of the tender-minded brotherhood to address the Education Section. Meantime, the tough-minded Mr. Wells has given to all interested in education, something to think about and something to follow up.

Social Theory and Discipline

(1) The Development of Sociology

By Prof. F. N. House. (McGraw-Hill Publications in Sociology.) Pp. viii + 456. (New York and London: McGraw-Hill Book Co. Inc., 1936.) 24*s*.

(2) Control in Human Societies

By Prof. J. Dowd. (The Century Social Science Series.) Pp. xvii + 475. (New York and London: D. Appleton-Century Co. Inc., 1936.) 16*s*. net.

(3) Ideology and Utopia:

an Introduction to the Sociology of Knowledge. By Karl Mannheim. (International Library of Psychology, Philosophy and Scientific Knowledge.) Pp. xxxi + 318. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1936.) 15*s*. net.

CURRENT interest in the co-ordination of views on the social responsibilities of scientific workers gives topical interest to these three volumes. From different angles they are all concerned with the contribution which science could offer to the solution of social problems, and more especially with the conditions and principles of scientific thought in this field. In turn they give us a broad historical survey of the subject, a practical study suggestive of lines of research and a stimulating contribution to original thought on the underlying principles of social theory and discipline.

(1) About half of Prof. House's comprehensive but not exhaustive account of the development of sociology is concerned with the growth of sociology in the United States, and particular aspects and characteristics of that growth. As an introduction to the extensive literature of this field and as a reasonably balanced survey of the development of thought on social questions, it can be commended to the growing number of scientific workers who, in considering the social consequences of their work or the place of scientific thought and method in social and political questions, are anxious to gain some background of theory and experience.

Some such background is essential whether we are concerned with the theoretical aspects of social science or with its actual technique in the handling of social and political problems on scientific lines, if only because nowhere in the field of science is the question of values more important than in social problems. The historic background gives the clue to the meaning of many social phenomena and has a practical bearing in the interpretation of present-day conditions and problems. It is a fundamental objective in the preservation and transmission of the social heritage.

Prof. House is sometimes a little too comprehensive to be as lucid as is desirable in the furtherance of the objectives so clearly set forth in his introduction, and more judicious selection would have made the work less tedious and increased its value to the general reader and student. None the less, he has traced clearly the development of social thought from its origin until it commenced in the eighteenth century to take on a form which may reasonably be styled scientific, and in the first two parts of the book ample justice is done to writers and thinkers in this field both in Great Britain and in Europe. His survey of American conditions notes a number of weaknesses of social research in that country which have already received trenchant criticism from Flexner, but suggests that the belief that sociology has important practical bearings on problems of citizenship, personal conduct and occupational problems may lead to it being regarded less as a subject to be taught to college students. On the other hand, he is a little sceptical as to the prospects of the integration of sociology, economics, political science and anthropology into a social science.

(2) Prof. Dowd, limiting himself to the evolutionary or dynamic aspects of society, gives us a comprehensive study of the controlling influences which determine the evolution of human societies and enters a strong plea for research on the lines advocated by Prof. W. McDougall in "World Chaos". The major part of the book, following a brief discussion of the origin and functions of control in society and a summary of the development of control in such varied fields as industry, religion, art, government and family life, which he summarizes as a transition from paternal to social control accompanied by an increasing individual opportunity, incentive and development, is devoted to a highly stimulating examination of the varied factors which are involved in problems of control which confront us at the present time.

This is a book which anyone who is interested in social problems to-day, whether of leadership or of the re-integration of society under the impact of science, can read with profit and with interest. Prof. Dowd gives a well-balanced treatment of the many factors which complicate these studies. His chapter on control in industry is highly suggestive and is an admirable corrective to the narrow angle from which industrial administration is sometimes approached. We have in it one more plea that industrial efficiency cannot be dissociated from social efficiency. No individual can be inspired to do efficient work unless he has opportunity, like the professional worker, to exercise his initiative, to share responsibility for the product and to receive recognition for his part in it, and the author lays a good deal of stress on the value of developing group loyalties and incentives of the professional type. He clearly believes that in the society of the future the motive of private profit will be insignificant and unnecessary.

Particularly to those who are concerned with the preservation of democracy and freedom of thought in the face of clashing systems of totalitarian States and social organization should this study make its appeal. The author never fails to recognize the need for discipline, and whether he is concerned with order in the State, in industry, or in the religious institution, he regards its development as of the first importance. Recognizing the fundamental principle of discipline that loyalty to group ideals and standards progresses from the smaller to the larger fellowship groups, he points out that the very existence of dictatorship is a confession of failure to engender the primary loyalties. Discipline, however, is not mere conformity to a fixed standard, but the acceptance of some ideal or principle as the determining influence in conduct and action.

This study of social control is in fact primarily a study of the meaning of liberty and its preservation. The ultimate object of social control is to facilitate the flowering of whatever genius or talent the individual may possess, and the main purpose of the book is to discuss the principles which may be applied in the development of a social order in which the individual can best express his personality and in which human relations may be most felicitous. This can only be achieved as a measure of discipline is accepted, at least sufficient to prevent a relapse to the social chaos which demands paternalism for its correction. Scientific workers at least should respond to the plea for the acceptance of group disciplines and larger loyalties, which will enable the individual to resist transient appeals likely to throw him out of his social orbit, no less than to the plea to enter on the wide fields of research now open to us.

Prof. Dowd makes many wise observations suggestive of lines of thought or study in respect of such matters as recreation as a social function, the relation between physical, moral and social efficiency, and professional or other occupational ability, or the growing significance of the service motive in industrial and business enterprise. He believes that if private business cannot be organized primarily to serve the public, it must give way to some form of State control, and he directs attention to the difficulty of effective discipline for citizenship if conditions are perpetuated which overstimulate man's desires for material possessions.

(3) Mannheim's work is scarcely one for the general reader, but is unquestionably the most significant of the three works as a contribution to the theory of sociology. Even in his discussion of the relation between social theory and political practice entitled "The Prospects of Scientific Politics", the author eschews the practical side and is concerned essentially with the fundamental principles by which effective action is determined. If, however, the book is primarily one for the specialist, apart possibly from the fifth section, which is little more than a scientific outline of the sociology of knowledge, written essentially as an article for an encyclopædia, it would be unjust to suggest that even the general reader will not find stimulating and suggestive passages in this work.

Prof. Mannheim lays a welcome stress on the necessity for precision of thought and on the interdependence and sensitivity to change and varying emphasis in the meaning of words. Thought, he points out, is a particularly sensitive index of social and cultural change, and few things have hampered progress in the development of the social sciences more than the loose and inaccurate terminology so often employed. Moreover, it is a rapidly changing intellectual world which makes possible the effective criticism of ideas and values formerly regarded as fixed. We need continually to recognize that every point of view is particular to a certain definite situation, and must be ready to determine by analysis the nature of this particularity. Knowledge is distorted when it fails to take account of the new realities applying to a situation, and when it attempts to conceal them by thinking of them in inappropriate categories. One of the weaknesses of the cultural sciences to-day is that they view their knowledge and formulate their problems abstract and torn from their concrete settings. To recognize more clearly this confusion is an enrichment rather than a loss, for the way out is to be won by the gradual extension and deepening of our insight and by careful advance in the direction of control.

The plea for fundamental thinking does not, however, lead Prof. Mannheim to understate the necessity for practical politics, though he does not attempt to elaborate even programmes for research in such fields. He clearly does not believe that the sphere of human activity on the mastery of which our fate depends will not yield its secrets even to scientific research. Nor is he to be numbered with those social scientists who believe that science must restrict itself to the causation of actual phenomena, that science is not concerned with what should be done, not with what ought to be but rather with what can be done, and with the manner of doing it. He has sought to trace the connexion between the actual interest groups in society and the ideas and modes of thought they espoused. He has shown that these complexes of ideas which direct activity towards the maintenance of the existing order do not merely direct thought from the object of observation, but also fix attention upon aspects of the situation which might otherwise be observed or unnoticed.

Prof. Mannheim has thus given us an effective instrument for fruitful empirical research. He also insists on the acuteness of the problem of objectivity in the social sciences, and the interest of the observer in the observed and the overwhelming influence of beliefs about the ends of action. He shows clearly also that the factors at work in the human mind impelling and disturbing reason are the same dynamic factors that are the springs of all human activity. The new discipline he outlines, which promises to give a fresh and profound understanding of social life, is supplemented by a clarification of some of the major moral issues of to-day. If the treatment is not always as lucid as might be desired, the book is none the less a significant contribution to thought in a field with which not merely the specialist but also all scientific workers and others interested in the deeper problems of to-day are increasingly concerned, and not the least of our thanks are due to the translators for the critical preface contributed by Louis Wirth.

R. BRIGHTMAN.

Fluorine Poisoning

Fluorine Intoxication:
a Clinical-Hygienic Study; with a Review of the Literature and some Experimental Investigations. By Kaj Roholm. Pp. xi + 364 + 47 plates. (Copenhagen: Arnold Busck; London: H. K. Lewis and Co., Ltd., 1937.) 20*s.* net.

FLUORINE intoxication from domestic or industrial causes is rare in Great Britain. For this reason the knowledge of its occurrence, causes and results is inadequate and restricted. In this recently published excellent survey in English of the clinical and experimental work on the subject, much useful information has been presented and the main points will be reviewed.

All fluorine compounds are toxic to man and animals. Taken orally, hydrofluoric acid solutions, sodium fluoride, hydrofluosilicic acid and sodium fluosilicate are highly toxic, calcium compounds being less toxic. Cases of acute poisoning from accidental and premeditated use are increasing. The compounds in the fatal preparations were either sodium fluoride or fluosilicate. Death occurred in all in less than twelve hours.

The cases of chronic poisoning can be divided into three groups. A small number of sporadic distribution are due to the use of insecticides for plants or animals, or rat poisons. A larger number occur in certain industries. Cryolite workers provide the largest number of cases, and it is the study of these that has been the important original contribution of Roholm's work. The other group of chronic cases represents the mildest but yet obvious form of fluorine effect, namely the 'mottling' of teeth. This occurs in localized regions, many instances of which have been recorded in the United States. Mottled teeth occur in Italy, Spain, Holland and England (Maldon, Essex). In all these regions the effects on the teeth are similar in type but different in degree. The teeth can only be affected during development; they are chalky white and later they become stained with unsightly dark brown patches or 'mottled'. The cause is the presence of sodium fluoride in the drinking water. Even two parts per million fluorine in the water can cause this, and so calls for a change of supply.

In Morocco and the Argentine there is a form of chronic poisoning called 'darmous' which results from the extensive fluorine-containing phosphorite rock deposits. The cattle are badly affected with a form of osteomalacia. Feeding rock phosphate can lead to this condition. The use of bone meal has so increased that the supply is inadequate and rock phosphate is used instead. It is essential that the latter should be fluorine-free. Vegetation in the neighbourhood of chemical works emitting fluorine is affected and can be a source of danger to grazing animals. Similar results have followed volcanic eruptions in Iceland.

The distribution of fluorine has been considered. This part of the subject is not in a satisfactory state because of the difficulty of determination of fluorine, especially in animal material. Fluorine is not a necessary element in nutrition, nor is it present in more than a trace in average teeth; even mottled teeth only contain 0·05 per cent of fluorine.

Roholm's special work has been the study of fluorosis among workers in a cryolite factory. Cryolite (Na_3AlF_6) deposits occur in Greenland, are quarried and shipped to the United States and Copenhagen. In the latter the working of the crude mineral to a fine pure state takes place. Those therein employed have been studied. The danger, one similar to that in silicosis, lies in the fine dust produced during the working. In all, sixty-eight workers, male and female, were examined (*questionnaire*, urine analysis and X-ray of limbs and pelvis). Gastric disturbances, palpitations, dyspnœa and rheumatism were the commonest complaints made by the workers themselves.

The X-ray examination revealed that intoxication was generalized, all bones being affected with a diffuse osteosclerosis accompanied by a calcification of ligaments. This was considered the most serious effect because it led to a decreased mobility of joints, in particular of the spinal column. The children of female workers in a few cases, where suckling had been prolonged, showed mottling of their permanent teeth. Experiments in which cryolite was fed to rats, pigs, calves and dogs verified the clinical findings, so that a clearer understanding of the workers' symptoms has been gained.

Convinced, then, of the toxic properties of fluorine, it is important to emphasize the sources of danger and possibilities of prevention. Danger lies in the manufacture and use of compounds of fluorine for insecticides, plant sprays, rat poisons and rock phosphate, for manure or cattle supplement. Prevention should aim at restricting the handling and hence the use of fluorine compounds. Where handling of minerals takes place, similar precautions are required as for silicosis prevention. Industrial waste containing fluorine should be converted to the least toxic compound, calcium fluoride.

My own inquiries in Great Britain have indicated that fluorosis has not yet been recognized as an industrial danger. Apparently fluorine minerals are not dealt with here. The danger, however, exists in the use of insecticides. A case of poisoning from accidental use of a chicken disinfectant was reported a little more than a year ago.

It is fortunate that a volume of such industrial, clinical and scientific value is available, in English, should the danger of fluorine intoxication become more common. M. M. MURRAY.

The Living World

Science of Life Series

By H. G. Wells, Julian Huxley and G. P. Wells. Vol. 1: The Living Body. Pp. xi + 223. Vol. 2: Patterns of Life. Pp. x + 239. Vol. 3: Evolution—Fact and Theory. Pp. x + 271. Vol. 4: Reproduction, Heredity and the Development of Sex. Pp. x + 222. Vol. 5: The History and Adventure of Life. Pp. x + 259. Vol. 6: The Drama of Life. Pp. x + 316. Vol. 7: How Animals Behave. Pp. x + 263. Vol. 8: Man's Mind and Behaviour. Pp. x + 271. Vol. 9: Biology of the Human Race. Pp. ix + 205. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1934–1937.) 4*s*. net each.

WE confess that we commenced to read with a certain prejudice, for we thought of the many distinguished authors who combined to write the "International Science Series" and cheaper "Primers" of still earlier date. Each wrote on his own speciality, and we assumed a certain virtue in this. We were sceptical in respect to this combination of literary capacity, of imagination and of learning, perhaps expecting that the latter on account of its 'youthfulness' would not be allowed its full play. However, we found ourselves reading Volume 1 on a train journey, and a volume has been our inseparable companion on all such for the last three months. We admit 'second childhood' with its consequent loss of memory—and thus our reading gave us pleasure, point following point as to life and the methods thereof, in such definite order that they produced in us a happy restfulness, not the boredom that induces sleep. We found a well-authenticated story and could read without the worry of hybrid names, too often coined to glorify an author rather than of necessity. "We ought to have a name for it." "Why?" "Well, someone else will give one, anyhow!" Far from valid reasoning.

Our authors are so merged that they might have been one. They start with "The Living Body"—and it is the human body—a machine reacting to its varied surroundings, its driver a nervous system, and efficient so long as it is properly fuelled and cleaned, until in course of time it wears out. This leads naturally to the various 'patterns' affected by animals and plants, and then our attention is directed to the way in which they may have been evolved. We are not allowed to assume without ample evidence the overwhelming positions of evolution and natural selection, which sometimes are rejected owing to man's pride or fear. 'Heredity' is all-important here, reproduction, sex and the body changes as the individual grows—a happily written and clear series of essays.

"*The History and Adventure of Life*", weaving it into the conditions of each geological stratum, naturally appeals, but a map showing the proportional length of time of each period is not accessible where we want it, the table given devoting two-thirds of its length to man, its post-War column especially in our opinion being out of place; this we disliked, but we found the rest of the volume corrective and admirable. The "Drama of *Life*" is scarcely a self-explanatory title for life in the sea and on land and in its waters, and the swaying balance between the animals and plants in communities (ecology). To us this quite learned volume shows a curious lack of those personal and humorous touches which we had become accustomed to expect, and which recur in full measure in the consideration of 'behaviour'—a separate volume is devoted to man—and of the "*Biology of the Human Race*".

Our suggestion to parents who have children going to a university for any science course, and to teachers, is to use these volumes so that their children or pupils may be educated, not merely crammed. There are nine of them, one for the summer vacation before the first term, and then one in each vacation until the student sits for final honours. The examinational result—whether the student is biologist, physicist or chemist—a certain understanding, will be great, and the candidate will have something which will add permanently to his interest in life, and will help him in his relationship with his fellows and his community.

The series is a reproduction in convenient form of the volume entitled "Science of Life", originally published in 1929 and reviewed in NATURE of March 28, 1931; the separate and handy little volumes now before us have been appearing at intervals since 1934.

Theism Restated

The Philosophical Bases of Theism

By Dr. G. Dawes Hicks. (Hibbert Lectures.) Pp. 272. (London: George Allen and Unwin, Ltd., 1937.) 8*s*. 6*d*. net.

THE substance of Prof. Dawes Hicks' book was delivered as the Hibbert Lectures in 1931. The volume is designed primarily for the general reader, especially for those "who have abandoned the resort of basing their religious trust on a miraculously attested revelation", and for whom, therefore, the philosophic approach to religion is indispensable. The author admits that "philosophy can as little provide us with a new religion as the science of ethics can provide us with a new morality"; yet "a religious mind which has reflected upon the principles upon which its religion rests, is clearly an advance upon the religious mind which has not so reflected".

Dealing with what is known as the cosmological argument for the existence of God, we may note that Prof. Dawes Hicks rejects the idea of a creation out of nothing. "This idea of Nothing, in the sense in which we take it when we oppose it to that of existence, is a pseudo-idea, and the problems which are raised round it are pseudo-problems." Furthermore, "the idea of creation as an event which occurred at a definite date in the past calls to be unhesitatingly rejected. . . . If the notion of 'creation' is to be sustained at all it can only be in the sense of continuous creation—of a constant dependance of the world on the supreme Being". The gist of the argument for the existence of God from the existence of Nature, is that "we are logically driven to acknowledge that there is a real existence beyond nature, unless we are prepared to rest in ultimate inexplicability, and to relinquish the attempt to frame any intelligible conception of nature at all".

In framing the teleological argument, Prof. Dawes Hicks stresses the point that Nature is strikingly adapted to human thought and reason, and in its very essence would seem to be intimately related to mind or intelligence. He alludes also to the work of the American biologist, Prof. L. J. Henderson, on the fitness of our material environment to support life. Countless other distributions of those three indispensable elements, carbon, hydrogen and oxygen, would have been no less antecedently possible, and yet we find "just *that* distribution, just *that* conjunction of properties, which is *fittest* for the maintenance of life".

Nor is the ontological argument overlooked by Prof. Dawes Hicks, and he does not admit that it was disposed of by Kant when he stressed the difference between 300 thalers in his mind and 300 thalers in his purse. For, after all, God is something very different from thalers, and as Anslem (who invented the argument) expressly affirmed, it was *only* in reference to the idea of the infinite that his argument had any significance. "This is an idea the content of which is wholly inexplicable by reference to finite, and therefore limited facts; and, accordingly, its mere presence in our consciousness is sufficient to establish the existence of a reality corresponding to it."

J. C. H.

Index to the Palace of Minos

By Dr. Joan Evans. With Special Sections classified in detail and chronologically arranged, by Sir Arthur Evans. Pp. vi+221. (London: Macmillan and Co., Ltd., 1936.) 31*s*. 6*d*. net.

PUBLICATION of an index in a volume separate from the main work would not in the ordinary course call for special comment, beyond note of the fact of issue. The index of "The Palace of Knossos" stands in a different category. The fact that the history of the Palace, as reconstructed in Sir Arthur's excavations, covers the whole of the Minoan age, and the scale in range and detail on which the index has been compiled, not only make it an indispensable aid to the use of the book, of which it is an appendage, but also constitute it a guide to the history of the period and its civilization at large.

Even that, however, does not exhaust its claim to be an essential tool of the historian and the archæologist. The appearance of Sir Arthur's name as joint author is no mere formality; and for certain entire headings, distinguished by his initials, he has been entirely responsible. As these headings are all of first-rate importance in the archæological and cultural sense, no one will quarrel with the author for having departed from the strict canons of the indexer. He has made each of them a chronological summary and survey of the subject with which it deals. The amount of detail which has thus been included may be judged from the fact that the entry for "pottery" runs to twenty-three pages, and many other heads of importance are treated on a like scale. The author's modest suggestion that the index may serve as a guide for those students who cannot afford the whole work does less than justice to its value and utility.

With a Spade on Stane Street

By S. E. Winbolt. Pp. xi+240+12 plates. (London: Methuen and Co., Ltd., 1936.) 10*s*. 6*d*. net.

STANE STREET, the Roman road running from Chichester to London, presents numerous problems, some of which have given rise to much controversy. The literature relating to it, in consequence, is considerable. Mr. Winbolt's contribution, however, cannot be regarded as in any way superfluous. Not only does he trace the road, field by field, in all its stages, but also he has submitted new and doubtful solutions for determining the line to the test of archæological excavation, where the application of this method has been possible. His verdict, therefore, may be taken as final. It is unfortunate that excavation has been possible at two only of the *mansiones*, or road-side stations. At Ewell, between which town and London the road is usually regarded as non-existent, the author has boldly attempted a reconstruction of the Roman town upon lines which, while purely conjectural, are supported by cogent argument. Mr. Winbolt is a strong supporter of an early date for the road, and maintains that its importance was due not to military exigencies, but to its use for public and commercial purposes.

Organische Synthesen (Organic Syntheses)

Übersetzt und für deutsche Verhältnisse bearbeitet von Dr. Richard Asmus. Pp. xii+586. (Braunschweig: Friedr. Vieweg und Sohn, 1937.) 45 gold marks.

IN the collected volume (1932) of the first nine annual volumes of "Organic Syntheses" (1921–31), several improvements were incorporated. New processes for several compounds were included, the descriptions of experimental procedure were enriched with small but important improvements, and indexes to reactions, substances and processes were provided. Such small but highly useful improvements as the statement of amounts of corrosive liquids and solvents in cubic centimetres as well as grams made a considerable difference in the practical utility of the volume. The descriptions are very full and references are given to the literature.

In the German translation the American materials and apparatus have been replaced by those obtainable from German firms and any necessary modifications of procedure introduced. By co-operation with the American editor-in-chief, Prof. Gilman, improved methods and corrections not to be found in the American edition have been introduced. The German edition will therefore be of interest to those who already possess the American volume, and it should prove most valuable to chemists who are more familiar with German than English. The paper and printing are good, and the translation appears to be careful and accurate.

The Future of Woman

By Anthony M. Ludovici. (To-day, To-morrow and After Series.) Pp. viii+152. (London: Kegan Paul and Co., Ltd., 1936.) 3*s*. 6*d*. net.

THIS little book forms a supplement to the author's "Lysistrata", which he now regards as too mild an indictment of feminism. As in his previous works, he maintains that one of the first and principal steps in the regeneration of the Western world is a masculine renaissance of man both as animal and as spirit. Feminism he regards as "nothing more than a government of odd people, by odd people, for odd people". In conclusion, he declares that there can be no solution of life's problems for normal women which leads them away from their normal function of nursing and training children.

Essentials of Modern Medical Treatment

By Dr. Vincent Norman. Pp. xvi+200. (London: Hutchinson's Scientific and Technical Publications, 1936.) 10*s*. 6*d*.

CONSIDERABLY smaller and less comprehensive than the well-known "Index of Treatment", to which numerous specialists have contributed, this volume, which is the work of a single author, is to be recommended to the practitioner and student for its lucidity, conciseness and up-to-date character, as well as for its considerably lower price. In addition to the eminently practical advice on treatment, a short account is given of the causation and symptoms of the various diseases.

Assam Origins in Relation to Oceania[*]

By Prof. J. H. Hutton, C.I.E.

IN choosing this subject I am not attempting to offer any definite solution to the problems of Indonesian migrations, but propose rather to examine one aspect of them in the hopes that I may elicit further information which may contribute towards the ultimate solution of what is really a complex of very difficult problems, as I feel that although a clearing up of the main question may be very distant, some analysis of the Assam side of the problem is perhaps possible.

Many parallels are to be found of one sort or another between Assam and Oceania, some of which were pointed out by Sir Henry Yule and by S. E. Peal in articles in the *Journal of the Anthropological Institute* in February 1880 and 1893 respectively, and others of which I myself indicated in an article on "Assam and the Pacific", in *Man in India* in 1924. In 1925 Henry Balfour pointed out cultural connexions between Assam and Indonesia in the matter of certain types of thorn-lined fish traps and, more recently, of fretted horn and shell ear ornaments.

It is fairly clear that identity of culture, in so far as it exists, is not that of a single culture, but rather of a complex of cultures in each case. It is certain that Assam may be able to throw some light on the Indonesian problem, as the stratifications can, at any rate to some extent, still be traced. The last immigrants are undoubtedly people of Kuki and Kachin affinities. There is a strong tradition among the Chins of the Arakan hill tracts pointing to their migration down the Chindwin Valley, no doubt throwing off parties which must have penetrated the Assam hills from the east on the way, after which one portion of the Kukis at any rate seem to have worked up northwards again from the Bay of Bengal, a movement which has barely ceased, if it has ceased, in the present generation. It would seem that the Kayans of Borneo probably formed part of the same movement. A tradition quoted by Hose and McDougall assigned the arrival of the Kayans in Borneo to the earliest years of the fourteenth century A.D., a date which fits well enough with Kuki and Tippera tradition.

Apart from such preceding migrations, of which there may have been many originating in movements in the Chindwin Valley caused by this southward Kuki-Kachin migration, and of which we probably have a memory in the traditions of the Angami Lhota and Ao movements from Manipur westwards, the two previous cultures in the Assam hills seem to have been definitely matrilineal and to have belonged to two types. One of these—and presumably the later—seems to have been analogous to the present Khasi and Synteng cultures, the other to that of the Garo and of the Kachari of the Assam plains. The Khasi migration clearly came from the east, and the parallel culture in Tonkin to their earliest remains in Assam is dated by Coèdes to about the beginning of our era. The Garo-Kachari peoples seem to have migrated from the north bank of the Brahmaputra, and while the Kachari is now predominantly patrilineal, as the Garo is matrilineal, both may still be said to be in the process of change as the result of contact between two systems.

It is interesting to notice that in Madagascar the Vazimba, who preceded the Hova as immigrants, had a number of features in common with the megalith-using Khasi, not all of which were afterwards adopted by the Hova. The latter, for example, built in wood, whereas the Vazimba used stone. One may also observe that Hocart, writing on the early Fijians, is inclined to think that the more civilized community was swamped by barbarians before the more recent migration of Polynesians from the east. Undoubtedly the Naga tribes at present represented by the Konyak Nagas in the north and to a lesser degree by Kachha Nagas to the south of the Naga hills, are associated with a more civilized culture in some respects than that of the intervening tribes who have come up from Manipur, always excepting the Angamis, who are in many respects *sui generis* and who probably have incorporated a very great deal of the civilization which preceded them on their present sites.

One important feature of the Konyak tribes, shared, it is true, by their neighbours the Aos, and in a ruder fashion by the Sangtam, Chang and Yimtsungr of the east, is the possession of enormous slit wood gongs to which I give the name 'canoe gong' on account of their shape. S. E. Peal was the first to report on these gongs, which he called 'canoe drums'; Prof. Henry Balfour calls them xylophones, and the only reason that I do not adopt his term is that I prefer to keep that name for the more usual type of xylophone consisting of a number of slats of wood giving different notes when beaten which is found among the Kuki, though not among the Naga tribes. These canoe gongs are the basis of an important cult intimately associated with head-hunting, and strongly suggestive of much that is associated with canoes in Oceania.

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[*] From the presidential address to Section H (Anthropology) of the British Association, delivered at Nottingham on September 3.

The true canoe gong with carved figure-heads and long hull like that of a dug-out is almost entirely limited to the Konyak, Ao, Chang and Sangtam tribes, and of these four undoubtedly the Chang and the Ao contain a large admixture of Konyak blood. The Sangtam only use a typical canoe gong in those villages which march with the Ao and Chang country. Farther south the shape is much less elaborate, and the Yimtsungr to the east of them used a mere hollow tree-trunk. South of the Sangtam tribe the canoe gong completely disappears except for the following instance: the Tangkul tribe use a remarkable form of gong, hitherto, I believe, unpublished, which might be described as resembling an inverted boat, the two ends of which are skeleton, while the centre part consists of the usual slit gong of more or less cylindrical type. The Angami use an unornamented wooden vessel of similar shape (without the skeleton ends) for the reception of liquor in bulk on ceremonial occasions, and one recalls Ellis's account of the man of Rurutu who came off to meet him "at a distance of two miles" from the island in a wooden food-vessel 6 feet long and 18 inches to 2 feet wide. A smaller slit gong of somewhat similar pattern, but much simpler, is used for scaring the birds from their fields by the Kachha Naga. Farther south again, the Zanniat Chins, who, unlike the other Chins, have a democratic organization, have a small slit gong not more than 6 feet long very like the Angami vat, while the Ngawn Chins use one of the same size not unlike the South American *teponatzli*, and put food in it on the occasion of a ceremonial dance.

It is interesting to observe that in South America the canoe gong appears to have developed independently from a hollow tree. It is, of course, possible that the canoe gong of the Naga hills has similarly developed from a tree trunk, but since we find no example of signalling by hammering on trees, we are perhaps entitled to argue that the process in Assam has been the other way, and that the smaller slit gongs, or the hollow tree trunks, used by some villages, are degenerate forms of the original gong which started as a canoe, and it is possibly significant that in the Kachin story of the great flood the two survivors escape drowning in "a large oval-shaped drum". On the other hand, it must be admitted that a simple form of slit gong occurs in Yunnan, as it does in Malaya and in Borneo, suggesting either marginal degenerations from a developed type in Assam, or possibly simple types from which the Assam one might have been elaborated. The real argument, therefore, for the canoe gong's being a survival from a real canoe rests on its associations with head-hunting and a typical canoe culture.

Now the Naga canoe gong is closely associated with the men's house, and generally, if not kept in it, it is kept in an annexe. It is in some respects treated almost as an idol, and tremendous effort is expended on carving it and dragging it up to the village. All human heads brought in are first placed on the canoe gong, at any rate by the Ao, suggesting the Marquesan practice of decorating the prows of their war canoes with the skulls of their enemies. When the gong is dragged up to the village over wooden rollers, such as those used in launching a vessel, the blood of the sacrificed animals is poured on to it, and in the old days any stranger, whether friend or foe, who came to the village on the day when a new drum was dragged in, was killed in order that his head might adorn the drum and his soul inhabit it. Indeed, until a head had come in, or had been brought in for the drum, a fence was put round it which could not be removed, nor could the drum be beaten until the young men had been out and fetched a head to remedy the defect. This head was first laid on the new drum.

The parallel with Melanesian canoe practice is here very close. Codrington writes as follows: "In the eastern Solomon Islands, if no victim was met with in the first voyage of a new canoe, the chief to whom the canoe belonged would privately arrange with some neighbouring chief to let him have one of his men, some friendless man probably, or a stranger, who would then be killed, perhaps as he went out to look at the new canoe. . . . Further west also captives were kept with a view to the taking of their heads when new canoes were launched." He goes on to give an example in a footnote: "The chief of Ravu bought his *peko* [war canoe] . . . for a large sum of money. It was brought over secretly and put into a . . . canoe house, where it stood till a head should have been procured. . . . In the morning a single man came by . . . in his canoe . . . they caught and killed him, set up his head at the prow of the [newly bought] canoe and paddled back to Ravu with shouting and blowing conch shells."

Nowadays in the Ao country a mock raid takes the place of a real one, but even this chastened sacrifice leads to a great success in hunting and in agriculture. The Ao gong nowadays wears a necklace of basket balls representing heads. Real heads were never used in this way, although they were laid on the gong when first brought in. These basket-work ornaments perhaps afford a parallel with the carved head which formed part of the figure-head of the Melanesian canoe. The figure-head of an Ao canoe is generally in the form of a buffalo or gayal head, that of the Konyak tribes an elephant, buffalo or hornbill head, but Peal, writing in 1893, remarks that the Konyak figurehead is (as depicted in his drawing) a crocodile, although "there are no crocodiles in these hills", and he points out that it is a familiar decoration in Indonesia and the Pacific. Although I have covered most of the ground visited by Peal in the last century, I have never seen any figure-head resembling the head of a crocodile, so that this tradition has apparently disappeared in the forty years since he visited the Naga hills.

It has occurred to me that the instruments used for beating the Naga canoe gong may conceivably be degenerate paddles. The ordinary type is more like the dumb-bell than anything, but often one end of the dumb-bell takes an ornamented form such as the hornbill's head, and in any event this 'dumb-bell' is not unlike a paddle in which the blade has degenerated to proportions similar to those of the handle.

F. E. Williams, writing of the Pairama ceremony in the Purari Delta in Papua, tells us that "when a successful hunt returned at evening the corpse of the victim was borne from the canoe to the *ravi* amid great enthusiasm. The men uttered that prolonged shout or roar which has a singularly exciting effect upon the listener, and rattle their paddles upon the sides of the canoes with the rhythm called *raruki raruki*. . . . On the following day the . . . hunter who first brings down the victim . . . is paraded in triumph through the village standing astride the canoe and balancing himself with a spear". It was formerly the custom of Meithei to signal across the Logtak Lake in the Manipur State in Assam by beating with their poles or paddles on the sides of their dug-outs as the Nagas do on a canoe gong, and I am further told by Mr. William Shaw, who served many years in the Manipur State, that some Kabui villages which have no canoe gongs still have the tradition of having used them once, while in Kabui Khulen village a sort of boat, with a high prow, is dragged in every year at the harvest festival "for all who have died in the past year". The best dressed of the young men rides on the boat, while there is a tug-of-war between the two clans of the village, one pulling at each end of the boat by ropes attached to pierced lugs left on when fashioning this dug-out, which is known as the *thingkhutong*—the plank to which a dead body is ordinarily fastened for burial in that village being called *thingkhu*. It must, I think, represent a boat or a boat-shaped coffin and be associated again with the fertility of the crops, so largely bound up both with the spirits of the ancestral dead, and of dead enemies, while the riding of the boat by the young warrior is reminiscent of the Pairama ceremony described by F. E. Williams.

Boat-shaped coffins are found occasionally in several of the Naga tribes, particularly in the Konyak country, where in one village at any rate they are associated with a tabooed chief, and it is worth noticing that a stone is put up by the Fijian 'spirit house' for each corpse brought in, precisely as the Konyak Nagas put up an erect stone outside the men's house for each head; and it is also remarkable that in one case, at any rate, there seems to have been a close association between the Fijian war canoe and the gong known as *lali*, since the chief Rokona named his war canoe Vatutulali, after his large gong.

The Samoans have a similar gong known as *longo*, the sound of which—according to Brown—will carry for twenty miles under favourable conditions. Brown also mentions that the Samoans struck the sides of their canoes with the handles of their paddles to mark time.

One more parallel is worth indicating in connexion with this subject. Writing in the *Journal of the Royal Society of Arts* of February 1937, La Valette illustrates the uptilted roofs of a branch of the Toradja tribe in Celebes, which he says are deliberately got from the prow and stern of a canoe, and are "bound up with the tribal traditions of their ancestors, who originally arrived from a country overseas to which the spirits of the dead must return". The roofs he illustrated are almost identical with forms common in one branch of the Konyak Nagas, east of the frontier of Assam.

I have elsewhere suggested a possible migration from Indonesia, and migrations from Indonesia to Ceylon and South India are placed by Hornell at about the beginning of the Christian era. I cannot help thinking that if, as I am tempted to believe, there was an Indonesian migration which swept upwards northwards into Assam before the Kukis came south, it must have been at an earlier date than that; at any rate there does seem to have been some expansion in many directions from Indonesia at a date which perhaps precedes the dates suggested by Coèdes and Colani for the megalithic civilization of south-east Asia. It would be interesting to know how far the stratifications of cultures in Oceania will correspond to the apparent succession in Assam of an Oceanic canoe culture, a matrilineal megalithic culture and that of a more recent patrilineal one associated with the Kayan and Kuki. The principal point which I wish to make, however, is that the hill cultures of Assam correspond to other distant cultures or combinations of cultures, all of which appear to be marginal in distribution from an Indonesian centre, and that there is some ground for supposing that migrations of culture, if not of people, have taken place from some centre in or near the Indian archipelago in various directions, one of which terminated in Assam.

Noise and the Nation*

By Dr. G. W. C. Kaye, O.B.E.

NOISE ON THE ROAD

THREE reports on road transport noise have been issued by a Departmental Committee set up by the Minister of Transport, and the position is that for the first time in Great Britain a comprehensive attack has been made on the problem of road traffic noise. To this end, loudness measurements, many thousands in number, have been conducted under widely different working conditions, on the over-all noise of some 800 motor vehicles, both new and old, representing all the main types on the roads to-day. The results (at a distance of 18 feet sideways or 25 feet to the rear) mostly ranged between about 70 and 105 phons (the latter value corresponding to a noisy road drill). The Committee was led to propose simple running and racing engine tests which are associated under specified conditions with an 'over-all' noise limit of 95 phons (roughly equivalent to the noise in a tube train) for all vehicles in use on the road, and of 90 phons for new vehicles leaving the manufacturer's works.

The adoption of these noise limits, while making very moderate demands on most types of vehicles would, by ruling out the arch offenders, constitute a substantial contribution to the amenities of the road. In the meantime, the industry, which has already discovered that 'silence is saleable', has the matter well in hand, and indeed it is not unlikely that future developments will not only enable manufacturers to meet the proposed requirements with comparative ease, but may indeed enable the limits to be lowered as time goes on.

To assist the motor industry in this laudable object, the Ministry recently set up four noise-testing stations in different parts of the country. At each of these stations an N.P.L. noise meter is installed, and manufacturers are enabled to submit types of their products and so ascertain for themselves how the noise levels compare with the limits proposed.

The whole question will be further facilitated when the simplified objective noise meter, which has recently been developed by the National Physical Laboratory for the Ministry, is put on the market. Such meters, which will be checked against the Laboratory standard meter, should, when available in quantity, be of great assistance at such time as it may be decided to bring into force regulations for dealing with noise on the road.

THE ABATEMENT OF NOISE

There are two guiding principles when the question of noise abatement is being considered. One is that the degree of abatement of a noise in a particular locality need be no more than will conform to the background of noise which obtains in that locality. The other is that in a medley of noises, the loudest must be tackled first to achieve any appreciable benefit, after that the next loudest, and so on. This is illustrated by the fact that if there are two similar components and one is 10 decibels less intense than the other, the weaker one will contribute only half a phon to the over-all loudness.

The first line of attack on noise abatement, and in general much the most effective and economical, is to tackle an objectionable noise at the source, and find the best means of reducing the output as much as possible. The next step, possibly as a confession of failure, is to find a feasible method of confining or 'smothering' the noise in the place where it is generated. In either case we turn to the engineer for help, and we may anticipate that he is likely to be the more interested if he can see a potential demand from the public.

The path of a noise in its journey from source to hearer may be either *via* the intervening air or *via* a sequence of solid materials or structures. Experience has shown that the two effects require very different remedies for abatement. The study of the general problem of noise transmission is more complex than might be imagined, and some of the major difficulties are not as yet completely resolved. For the practical elucidation of the various factors involved, specially designed 'sound-proof' laboratories, such as those at the National Physical Laboratory, have proved to be necessary. Parenthetically, it may be mentioned that the N.P.L. acoustics laboratory, since its erection four years ago, has been so fully engaged in transmission and absorption work, mainly for the architectural profession and the building industry, that extensions are now in hand and should be available for use by the end of the year. Much research work on building acoustics is also being carried out for the Ministry of Health in connexion with slum clearance, and for the Architectural Acoustics Committee of the National Physical Laboratory and the Building Research Station.

To revert to the case of a non-suppressible noise, if most of the noise is transmitted by air, the best

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(Continued from p. 449.)

remedy, should circumstances render it practicable, is some sort of sound-proof enclosure, the design of which may need careful attention both as regards weight and discontinuity of structure. There is, of course, no such thing as a sound-proof material, and success in sound insulation is largely a matter of design.

Certain large-scale operations may require 'sound-proof' buildings to mask them, the doors and windows of which should be heavy and close-fitting and preferably situated on the side remote from that where the noise is liable to be regarded as a nuisance. Doors and windows, particularly high windows and skylights, may require to be doubled and, in extreme cases, it may be necessary to employ double walls mounted on independent foundations. Buildings in which noisy operations are carried on should, if possible, be put under the lee of larger buildings, which may afford advantageous shielding to the locality. In the interior of noisy buildings, it is usually beneficial to the workers to divide groups of noisy machinery, so far as may be possible, into smaller units, each in its own enclosure. Appreciable benefit may also result from lining walls and ceilings with acoustical absorbent, so preventing the noise level from building up unduly.

In the case of structure-borne noises, the remedy is discontinuity somewhere in the structure either in the form of an air gap or as resilient material, for example, under the foundations of noisy or vibrating machinery.

Modern building design and materials do not provide protection from noises, whether from inside or outside, like the more solid houses of a generation ago. The noise problem is accentuated in the case of the large blocks of flats which are being erected in all quarters, and which apparently are mainly adapted for quiet tenants who are prepared to conform in this respect to a landlord's reasonable requirements. The situation lies largely with local authorities, who should lay down building by-laws, setting forth minimum standards of acoustic insulation. The architect and builder have of necessity been driven from traditional methods of construction to meet the economic requirements and closer scientific designing of to-day. Discontinuity of structure and the use of massive and poorly conducting materials formerly provided defence against sound, but instead we now have monolithic structures which are not only thinner and lighter than the old, but also are composed of good conducting materials. The steel-framed and ferro-concrete building, cement mortar, hard bricks and plaster, to say nothing of a general ramification of central-heating, running water and other piping, have replaced the softer brickwork, lime mortar and plaster, wooden beams, joists and studding, and the localized piping of the older houses. No one pretends, of course, that we can go back to the old methods, but if we are to mitigate the noise nuisance in modern buildings, we must adopt measures which are best incorporated during the designing stage.

There is, too, another aspect which should be clearly appreciated, and that is, if sound insulation in buildings is desired, it has to be paid for. The public, at present enticed with a plethora of labour-saving devices by landlords of flats, has yet to learn that reasonable acoustic privacy is obtainable provided it is prepared to face a small proportionate increase in the rent.

Structure of Protein

THERE can be few problems of predominantly chemical interest which are being attacked by such a variety of methods of investigation as that of protein structure. This was well illustrated by the symposium on protein chemistry held on September 3 in Section B (Chemistry) of the British Association, in which the contributions ranged in subject from biochemistry to mathematics, each justifying its inclusion either by the addition of some significant fact to the total sum of knowledge or by the formulation of a stimulating hypothesis to account for facts which still await complete explanation.

The foundation of protein chemistry as we know it to-day has been laid by organic chemistry, which, chiefly in the hands of Emil Fischer and his pupils, has provided not only detailed information concerning the composition of proteins, but above all the unquestionable demonstration of the peptide linkage as the predominant feature of their intramolecular structure. Moreover, through the development of improvements in peptide synthesis, particularly the carbobenzoxy method, organic chemistry has provided a wealth of material which has illuminated the mode of action of proteolytic enzymes and which now promises to throw light on the physico-chemical behaviour of proteins and even perhaps on their immunological specificity. These points were brought out by Prof. C. R. Harington (London) in opening the symposium, but he was at the same time at pains to emphasize that the peptide theory in its simplest form is unable to account for all the properties of proteins, which can only be explained by the assumption of subsidiary linkages within the molecule.

The importance of the peptide linkage was further emphasized by Dr. K. Linderström-Lang (Copenhagen), who pointed out that this linkage is the only one known with certainty to be attacked by proteolytic enzymes. These enzymes, as is well known, may be roughly classified into the proteinases which attack complete protein molecules or their higher degradation products, and the various peptidases which attack peptides at points adjacent to free amino or carboxyl groups or both. Dr. Linderström-Lang directed attention to the interesting evidence which has recently accumulated that the true proteinases owe their peculiar specificity to the fact that they can only attack peptide linkages remote from free dissociating groups.

One of the greatest advances in the understanding of the physico-chemical behaviour of amino-acids and proteins is due to the zwitterion theory introduced by Bjerrum in 1923. The development of this theory and the evidence for its applicability to amino-acids was discussed by Dr. A. Neuberger (London), who laid particular emphasis on the good agreement to be observed between the experimentally determined dissociation constants of amino-acids and those calculated on the basis of the theory; evidence derived from dissociation constants of amino-acids other than α-amino-acids shows that such molecules exist in solution in a relatively unbent condition with the charged groups far apart, thus accounting for the high electrical moment required by the zwitterion theory. Dr. Neuberger proceeded further to demonstrate the fact that it is now possible to interpret the electrometric titration curve of a protein with reasonable accuracy in terms of the polyvalent amino-acids which it contains, the additional dissociating groups of these amino-acids being the factors which determine the electrochemical behaviour of the protein molecule as a whole.

The determination of the very large molecular weights of proteins is a matter of considerable difficulty, and no method has afforded more valuable information on this point than the ultracentrifugal method evolved by Svedberg. This procedure was described by Mr. J. St. L. Philpot (Oxford), and was illustrated by a very beautiful application in which the molecular weight of the enzyme xanthine oxidase was observed by its rate of sedimentation from a solution containing the enzyme system, methylene blue and iodate; the solution, at first colourless throughout, becomes coloured from the top downwards in the ultracentrifuge owing to re-oxidation of the leucomethylene blue by the iodate as the enzyme is removed.

The remaining two contributions to the symposium were chiefly concerned with the nature of the subsidiary linkage in the protein molecule, which was referred to by the opener. The evidence to be derived from X-ray measurements was discussed by Dr. W. T. Astbury (Leeds), who recalled his well-known earlier work on the structure of the keratins, showing these proteins to be made up of bundles of peptide chains joined by subsidiary linkages which might be either the disulphide linkage of cystine or so-called hydrogen bonds or covalent linkages of unknown nature. It was pointed out by Dr. Astbury that X-ray measurements indicate a transition in structure from the stretched keratin or myosin molecule, through the partly folded molecule of unstretched keratin as it occurs in hair, to the completely folded molecule of the 'globular' proteins such as insulin. The evidence provided by X-ray measurements regarding the mechanism of denaturation of proteins was also discussed; it appears that this process certainly involves rearrangement and unfolding of peptide chains, but it seems to the present writer at least that the real nature of the phenomenon remains as obscure to physicists as it is to chemists.

Of the various theories of protein structure which have been proposed from time to time, few are of greater interest than the 'cyclol' hypothesis advanced on geometrical reasoning by Dr. D. M. Wrinch (Oxford). This theory, which has already been presented in a series of communications to NATURE, was briefly outlined by Dr. Wrinch, who claimed with justice that it is in fact a logical development of the peptide hypothesis built up within the framework of existing knowledge. The criticism of Dr. Linderström-Lang that the cyclol molecule contains linkages of a type not known to be attacked by enzymes was met by Dr. Wrinch with the admission of the possibility of spontaneous breakdown of the structure following initial enzymic rupture of the normal peptide linkages, which it does in fact contain.

The symposium was closed by two brief but interesting contributions, from Dr. Irving Langmuir on the possibilities offered by the study of protein films, and from Dr. D. Jordan Lloyd concerning the important physico-chemical work of Cohn and his collaborators at Harvard.

The general impression left by the symposium was that the problem of protein structure can only be solved by a combination of all applicable methods of attack. The listener was left in no doubt as to the magnitude of the problem, but nevertheless with the feeling that improvements and new developments of technique are now forthcoming at a rate which affords justifiable hope of its solution in the not very distant future.

Health and the Community

On September 2, the physiologists of the British Association for the nonce forsook their frogs, cavies, rabbits and almost, but not quite, their rats. They left the cloistered calm of controlled experiments *in camera* and the discussion of intricate problems of nerve conduction or surface films, interesting, no doubt, to those who have at least mastered the terminology but deadly dull to those who have not, and descended to the world of men, and to a consideration of the criteria of the healthy life both of man as an individual and as an integer in a community. They could not, however, quite part with the rat. The important part this rodent has played and is still playing in the progress of civilization would need a whole article to describe, but we only heard of its value in assaying food for certain vitamins, and were warned of the dangers of accepting results obtained from experiments on rats as applicable without reserve to man. For example, the anti-vitamin D influence of cereals—so clearly demonstrable on rats and puppies, due to the absence from their alimentary tracts of an enzyme capable of freeing phosphate from *phytin*—leads to low-phosphorus rickets, a condition unknown in man. The breakfast cereal, whether provided dry or as Scots porridge, thus leaves the physiological court of appeal without a stain on its character, or, to be more cautious, with the Scots verdict "not proven".

Experiments on animals have given valuable information, and they are still necessary, especially for purposes of assay, but before far-reaching conclusions of value to the community can be drawn, they must be shown to be valid for man by long-term experiments on man. Before these can be attempted, some measure of agreement must be reached as to standards of performance. What is a healthy man ? How can his health be measured ? It is all very well to talk of the bloom of health, the clear eyes, silky sheen of hair, easy upright carriage and the pleasant facial expression of those physiologically fit, but these qualities are immeasurable. They have no yard-stick. As standards are necessary, such items capable of measurement as height-weight ratio, chest expansion and absence of demonstrable fatigue after moderate work have to be used for want of better. A person may be called normal if he does not depart more than ±5 per cent from the average.

This led to a discussion on sub-nutrition—a vague lack of efficiency demonstrably due to inadequate intake of the so-called protective foods. The threshold for these foods varies from individual to individual, some requiring more and some less to enable vital processes to be carried on at full efficiency ; so, to play for safety in planning diets for large groups, maximum amounts should be given (not necessarily taken). Laboratory animals have been shown to suffer from excess of these foods. In fact, many diseases common to man may have symptoms similar to those produced by overfeeding rats with certain dietary constituents, but the overfeeding has to be gross. So far, no ill effects have followed luxus consumption by a healthy man of any article of diet taken in the ordinary course.

Health and industrial efficiency are not quite synonymous terms, but there is no doubt that ill health causes large industrial losses. The Section had, as guest speaker, Dr. E. Atzler of Dortmund, who told, in fluent English, of his attempts, which met with a large measure of success, to raise the industrial efficiency of the workers in Westphalia. He stressed the value of slow adaptation to working conditions. The operative starting work under new conditions has to become acclimatized, and unless this is done carefully his efficiency and his general health may be impaired. He directed special attention to mineral metabolism—the need for phosphates being noticeable in those about to undergo heavy muscular work, and for chlorides when the work was to be done under semitropical conditions. These mineral needs are less after the worker has become 'hardened' to his job.

The Section turned its attention to more general problems. It was told of a steadily decreasing birth-rate, especially in those classes more financially comfortable. It has been computed that for every hundred women aged twenty-five years in England and Wales to-day, there would be only 83 in 1942, 70 in 1952 and 60 in 1962. Whatever we do now, these figures cannot be increased. Further, there is a tendency to postpone marriage in the better-off classes. Thirty-six per cent of the women of the professional classes who marry do not arrive at the altar until they have passed thirty years of age. The corresponding figure for miners is 10 per cent (Reg. Gen. Report for England and Wales, 1921). Even those who marry younger tend to postpone childbirth. To determine the safest age for reproduction, that is, the age with the lowest death-rate for mother and child, necessitates the close study of a large area with a fairly stable population. Figures were given of 30,000 mothers, 98 per cent of whom came from the classes covered by State insurance. It was made clear that the safest rate of reproduction for both mother and offspring was the *modal* rate, that is, when the first pregnancy occurred when the mother was round about twenty-five years of age, the second, third and fourth between the ages of twenty-five and thirty and not more than three pregnancies in the next five years. *On the whole*, this rate was observed only by the lower paid members of the community. As income (or security of tenure) improves, there is a tendency to postpone the first pregnancy, with obviously a shortening of the reproductive period and, statistics showed, with a consequent increase both in maternal mortality and in the number of still-births. The increase in still-births is almost offset by the decrease in child mortality. The result of this is that those who are least able to obtain the necessary food for full health are the very people who are contributing most to the maintenance of the population. To improve the condition of the child-bearers and incidentally of the children born, education in food values and other physiological truths is not of much use unless the necessary food and service are available at a price to suit their incomes and conditions of life. D. B.

Obituary Notices

Mr. A. Sharples

MR. ARNOLD SHARPLES, formerly mycologist in the Department of Agriculture, Federated Malay States and head of the Pathological Division of the Rubber Research Institute of Malaya, died at St. Anne's-on-Sea on August 6, after a long illness.

Mr. Sharples was born at Great Harwood, Lancashire, on November 25, 1887. He received his elementary education at Stoneyholm School, Burnley. He left school early, but later, overcoming great difficulties, he became a student at the Burnley Technical College, where in 1908 he won a scholarship to the Royal College of Science, London, and at the same time was awarded King's prizes in both geology and mineralogy. At the Royal College of Science he was especially interested in botany and came under the notice of Sir John Farmer as a particularly promising student. He became an associate of the Royal College of Science and was awarded the diploma of the Imperial College of Science in 1912. His interest in mycology had already been stimulated by his association with north-country naturalists, especially the late Mr. James Needham of Hebden Bridge. On leaving the Royal College of Science he was appointed assistant mycologist in the Department of Agriculture, Federated Malay States, but before going to the East he spent some time at Kew to extend his knowledge of mycology under the direction of the late Mr. G. Massee and Miss Wakefield. All his professional life was spent in Malaya. In 1916 he was appointed chief mycologist in the Department of Agriculture, and in 1930 he was seconded from Government service to be head of the Pathological Division of the Rubber Research Institute of Malaya, situated at Kuala Lumpur. He retired in 1934 and settled at St. Anne's-on-Sea.

During the Great War he served in Mesopotamia (1917–19) as a lieutenant in the Royal Engineers. In this capacity he was concerned with the purification of water supplies for the troops.

From the time of his arrival in Malaya until his retirement, Sharples was a most energetic and able investigator of the diseases of tropical crops, especially rubber. From 1914 onwards there was a constant stream of papers from his pen, published by the Department of Agriculture or the Rubber Research Institute, or appearing at home in the *Annals of Botany* and the *Annals of Applied Biology*. At one time or another he covered the whole range of rubber tree pathology. He treated exhaustively, sometimes in association with colleagues, such diverse topics as the spotting of plantation rubber by mould fungi, pink disease, the root and branch disease of rubber trees caused by *Ustulina zonata*, mouldy rot and brown bast of the tapped bark, lightning damage to coco-nut and rubber trees, and callus formation in tropical plants. These and other investigations were marked by thoroughness and insight. Sharples was not content merely to investigate a disease sufficiently to give advice to planters, but being interested in the fundamental aspects of plant pathology, he examined in great detail the relations of plant and parasite or other disease-producing agency in connexion with environmental conditions. His account (with H. Gunnery) of callus formation in *Hibiscus* and the rubber tree (*Annals of Botany*, 1933) is probably the best description available of the development of this tissue. His wide botanical interests prevented him from becoming a narrow specialist. Sharples was an example of the best type of officer in the tropical departments of agriculture, who realizes both the practical and the fundamental issues involved in problems of crop cultivation.

Sharples had a profound knowledge of all matters concerning rubber cultivation in Malaya, and his advice was constantly sought by the planters, with whom he was always on the best of terms. They had complete confidence in him. He will long be remembered with gratitude by the planting community of Malaya. During his service with the Rubber Research Institute he acted as director for a period.

After retirement, Sharples devoted his leisure to writing an up-to-date book on the "Diseases and Pests of the Rubber Tree" (Macmillan and Co., Ltd., London, 1936). This was a most notable addition to books on the diseases of tropical crop plants ; it is, in fact, a treatise on the principles of plant pathology with particular reference to rubber cultivation, and is eloquent testimony to the enlightened outlook which Sharples had on the problems of disease in plants. Unfortunately his health began to fail shortly before the publication of this book, and he died at the early age of forty-nine years. It is sad to think that after such a strenuous life in the East he did not live to enjoy the leisure he had so richly earned.

Personally, Sharples was something of a 'rough diamond', albeit his outspokenness became mellowed with age. He was entirely sincere and courageous in his opinions, and no one was ever a more loyal and kindly friend than he. His high achievement in spite of early handicaps is striking testimony to his sterling character. In an enervating climate he maintained his energy in an astonishing manner : tropical ennui never affected him. In any joint investigation he always pulled his weight, and generously shared credit with his colleagues. As a young man, he was keen on association football and in later life he was fond of tennis and golf. He married Edith Thornton in 1917, who survives him. There were two sons of the marriage, one of whom died a few years ago.

Prof. J. G. Thomson

PROF. JOHN GORDON THOMSON, director of the Department of Medical Protozoology at the London School of Hygiene and Tropical Medicine, whose death took place in London on August 13, was one of the few outstanding medical protozoologists in Great Britain. In addition he was, and continued to be until shortly before his death, a well-known investigator of tropical disease in the field.

Prof. Thomson commenced his career at the University of Edinburgh, where he graduated M.A. in 1903 and where he qualified in medicine with honours in 1908. Two years after qualifying he was appointed Durning-Lawrence research fellow in tropical medicine at Liverpool and later, 1912–13, pathological research fellow at the Liverpool School of Tropical Medicine. During his time at Liverpool, where he worked under Sir Ronald Ross, he carried out many researches on trypanosomiasis and on cultivation of the malaria parasites. His work in this last connexion, which was done largely in collaboration with his brother, Dr. D. Thomson, was perhaps that for which his name was best known.

In 1914 Prof. Thomson was appointed lecturer in protozoology at the London School of Tropical Medicine, but on the outbreak of the Great War he joined the Forces and proceeded in 1915 to Egypt, first as member of a commission to study bilharzia in that country and later as protozoologist to the Central Military Laboratory at Alexandria. On his return to England he was appointed officer in charge of the Malaria Research Laboratory at the War Office, where again he was associated with Sir Ronald Ross. Whilst in Egypt and later, he published many papers on amœbic dysentery and other intestinal protozoal conditions, as well as studies directed to the finding of satisfactory serological tests for malaria.

In 1918 Prof. Thomson took up the duties of the appointment at the London School of Hygiene and Tropical Medicine which he held at the time of his death ; there he worked in post-graduate teaching and in the carrying out of many researches. In 1921 and again in 1922 he went on an expedition to study blackwater fever in Rhodesia. The results of these investigations were presented in a memoir, published by the School, which is now one of the best-known standard accounts of this disease. In 1924 he visited the West Indies, Honduras, Guatemala, Costa Rica and Panama. In 1934 he visited and carried out investigations in Nyasaland, studying more especially the indigenous malaria, and at various times he visited other tropical countries. In the intervals of travelling and demands made on his time by teaching, he published many papers on protozoological subjects and was joint author in Thomson and Robertson's "Text Book of Protozoology", a very useful and condensed source of information on the subjects dealt with.

Though Prof. Thomson worked at many different problems, the malaria parasites were always his favourite study, and even up to shortly before his death the nature of malarial immunity and drug treatment in malaria were much engaging his attention. Prof. Thomson's name is one familiar to research workers in tropical medicine both of British and of other nationalities, and his death will be a loss not only to his colleagues and many friends but also to a very wide circle where his work was known and appreciated.

Prof. Luigi Pernier

WE regret to record the death of Prof. Luigi Pernier, professor of archæology and the history of ancient art in the University of Florence, which took place in Rhodes at the age of sixty-two years in August last, while he was attending the Dante Alighieri course of "Alta Culture". His death is a great loss to archæological studies in Italy, more especially in connexion with the investigation of the sites of the early civilizations of the Mediterranean area.

Luigi Pernier was born in Rome on November 23, 1874. On completing his education, he was appointed to the Administration of Antiquities, and took part in the Italian archæological mission to Crete in 1900, acting as director of the excavations at Festos. In 1909 he was appointed director of the Royal Italian School of Archæology at Athens and of the "Missioni Italiani in Oriente". While he was head of the School, archæological explorations were carried out in Crete, Delos, the Sporades and Euboea under his direction. In 1916 he was appointed director of the

Archæological Museum of Florence and of the Musei i Scavi dell'Etruria, when he was responsible for the excavation of Vetulonia, Arezzo, Cortona and Orvieto, investigations of the first importance for our knowledge of the Etruscan civilization. After his appointment as professor of archæology in the University of Florence in 1922, he also became head of the archæological mission to Cyrene, where important excavations were carried out under his charge.

WE regret to announce the following deaths:

Prof. A. J. Ewart, F.R.S., professor of botany and plant physiology in the University of Melbourne, aged sixty-five years.

Miss A. Lorrain Smith, O.B.E., formerly of the British Museum (Natural History), known for her mycological studies, on September 7, aged eighty-three years.

News and Views

Heavy Nitrogen

AT a recent meeting of the American Chemical Society Prof. H. C. Urey reported that he had prepared heavy nitrogen in considerable quantities (see also p. 512). Ordinary nitrogen has long been known to consist of two isotopes of mass numbers 14 and 15, the heavier one being present, however, to only four parts in a thousand. Isotopes of several elements have been already separated in a fairly pure state; of these hydrogen and deuterium are the best known, but other examples are lithium 6 and 7, and neon 20 and 22. The difficulty of the problem solved by Prof. Urey can be appreciated by comparing it with that presented by the neons, where the percentage difference in mass is greater and also the heavier isotope is naturally present to the extent of nearly 10 per cent, instead of the half per cent in the case of nitrogen. It is stated that the heavy isotope is being separated at the rate of a quarter of a litre a day. The separation of pure heavy nitrogen will undoubtedly lead to a great deal of important work in nuclear physics. Nitrogen 15 differs from nitrogen 14 simply in the structure of its nucleus, there being one more neutron present in the heavier type. Ordinary nitrogen has already proved most interesting, since it can be disintegrated in a variety of ways by bombardment with α-particles, neutrons, protons and deuterons. The investigation of the behaviour of heavy nitrogen under the same conditions should lead to valuable conclusions about the effect of the extra neutron in the nucleus. It has also been suggested that heavy nitrogen will be of great service for research in physiological chemistry, since various substances which are important in the body can be made containing some heavy nitrogen instead of ordinary nitrogen, and while their behaviour will be unaltered, these particular molecules can always be identified later by means of the heavy nitrogen atoms.

Mentality of Fish

DR. J. GRAY's evening discourse to the British Association delivered on September 6 at Nottingham shows how closely the reactions of fishes resemble those of man. In the behaviour of man the involuntary machine-like reflex plays a very important part, and in a fish that is swimming freely the movement involves a high degree of co-ordination between a large number of muscles; the whole of this highly co-ordinated mechanism being completely independent of that part of the fish's brain which corresponds to our cerebral hemisphere and therefore to that part of the brain which is associated with consciousness in ourselves. It is well known, however, that a fish may be trained to make mental associations, and in the last few years the problem has been subjected to rigid scientific investigation. By experiment it is found that a fish is sensitive to a great variety of gentle stimuli such as a very slight change in temperature and the shape and colour of objects in its vicinity. Fish are also capable of carrying out highly complicated migratory excursions. In these types of behaviour Dr. Gray asks us if we do not see most if not all the activities of the human race. Almost certainly the association powers of a fish are on a much lower level than those of man, but the power is there, and it is difficult if not impossible to put our finger on any one of our mental powers and say, "Herein are we a race apart, elevated above the rest of the world". Dealing with the migratory experiments with the Pacific salmon, in which that fish is proved always to return to its own native waters, he says, "I venture to think that if we were to have carried out comparable experiments on a race of human beings, and got similar results, we would have said 'They do it, as you or I would do it, consciously noting the landmarks, memorising them, and so retracing their steps'—in fact they are performing a conscious act, a premediated, thoughtful, and purposive act. Are we to apply the same conclusions to the fish—if not, why not?"

Rivers and their Formation

IN connexion with the recent British Association meeting at Nottingham, a public lecture on "Rivers", which was abundantly illustrated, was delivered by Mr. R. Kay Gresswell in Lincoln on September 3. Mr. Gresswell pointed out that when a river has once been formed, by virtue of its motion the water is able to carry a load consisting of rock actually dissolved in the water and also of finely powdered rock and pebbles of all sizes, which serve as eroding agents. When it has acquired a load, the river can use it as a kind of file or battering-ram with which to erode its banks and bed and so add to the quantity it is transporting until it becomes fully laden. The main features of a river are the direct result of the water constantly trying to adjust its bed to suit its load. If the river enters a reach fully laden and the slope is such that the water continues to flow at its original speed, then just as much material will leave that reach as enters it and so no erosion takes place. Should, however, a fully laden river enter a reach the slope of which is less steep than it has been upstream, the rate of flow of the water will be decreased and a proportion of the load is then deposited. This mostly occurs at the beginning of the reach and thus the river gradually steepens the slope until it becomes sufficient for the entering load to be carried through.

IN the lower part of its course, a river normally enters upon a plain. Here the rate of flow is greatly diminished and the fully laden river proceeds slowly towards the sea. In turning a corner, the speed on the outside of the curve is always much greater than that on the inside. This results in the water on the outside being able to take on an additional load and thus erode the bank. Conversely, the water on the inside is unable to carry the whole of the load it already possesses and deposits sediment on the inside of the curve. The bend thus becomes steeper and steeper, and it is owing to this action that rivers always meander in the plain tract. Quite commonly the river still does a little actual erosion and in consequence by the continual change of position of the various loops of the meanders, the general level of a strip of land, about one or two miles wide in the case of rivers the size of those found in England, is gradually lowered, the edges of this band, which mark the extreme limit of past meanders, often forming steep cliff-like slopes. If, as the result of earth-movements, the general slope of a river-valley be increased, the river flows more quickly and is thus able to increase its erosion. It sometimes happens that a meandering river is thus re-juvenated, and in that case the river deepens its bed in the shape the meanders then happen to possess. The land between the individual loops are then in time left standing high above the new low river-level. This has happened in the case of the River Wye in Monmouthshire, and has resulted in very beautiful scenery.

Fauna and Climate in Early Palestine

IN view of the interest of the various geographical and distributional problems in the prehistory of Palestine, to which a notable contribution has been made by the preliminary examination of the finds in the bone-bearing beds of Bethlehem (see NATURE, Sept. 4, p. 431) attention may be directed to a communication from Prof. L. Picard, of the Hebrew University, Jerusalem, which appears in the recent issue of the *Proceedings of the Prehistoric Society* (Jan.–June). Prof. Picard there examines in detail the data of palæontology, geology, archæology and stratigraphy in their bearing, first on the climate of Palestine in prehistoric times, and secondly on the origin and geographical relations of the fauna of that period. Writing before the publication of the evidence from Bethlehem, he concurs with Miss Bate's previously published conclusion as to the complete absence from Palestine of a boreal (cold period) fauna, though its existence has been asserted; but he is unable to accept her interpretation of the palæontological evidence as pointing to a change from a forested landscape with humid conditions to a drier climate and more open country. He finds that while there were a number of forms, now extinct, contemporary with the old Acheulean—the earliest evidence of man's handiwork then available to him—some of these, such as probably the hippopotamus, survived even so late as Biblical times.

As a whole, the various classes of evidence (in palæontology, trees and plants, as well as land and aquatic fauna) are interpreted by Prof. Picard as concurrently pointing to the fact that no important change in climate takes place down to recent times. In fact, the present climatic conditions, the aridity of the eastern section and the Mediterranean or 'etesian' climate of the western, existed in the Pliocene, and date back to the Upper Miocene. Further, the geographical conditions in the south were such as to preclude migration to, or from, Africa in the Pleistocene. The fauna which has been designated as African-Asiatic has been domiciled in Palestine since the end of the Miocene and can be regarded as endemic during the Plio-Pleistocene. The problem, it will be seen, is of considerable general interest, but to palæontologist and archæologist more especially in relation to recent discovery in East Africa. Further evidence from Bethlehem will be awaited eagerly.

Human Skeletal Remains in London

EXCAVATION work in Farringdon Street, London, E.C.4, for the foundations of an extension of the offices of the *Evening Standard* has brought to light a large number of human skeletal remains. About three hundred skulls and two thousand other bones have been found. It is suggested that the excavation may have opened one of the pits in which victims of the great plague of 1665 were buried indiscriminately. There were a number of these pits situated in various parts of London. One of the largest was in Tothill Fields, Westminster, near where Caxton Hall now stands; another near Newgate was adjacent to the site of Christ's Hospital, the Bluecoat School, demolished for the extension of the Post Office, and still another was in Whitechapel. Dr. A. J. E. Cave, of the Royal College of Surgeons, who has inspected the recent finds, is of opinion, according to a statement published in the *Evening Standard* of September 10, that, judging from their condition, they are probably the skeletons of men, women and children who died in the seventeenth century and may well have been victims of the plague. They are all of the same type, and differ but very slightly from typical skulls of to-day. Though they have not yet been submitted to an exact examination, Dr. Cave is stated to have said that the skulls appear to have a vault a little more pointed than the modern skull. It will be remembered that Prof. F. G. Parsons some years ago examined a large number of seventeenth and eighteenth century skulls of Londoners, when a graveyard, presumably of the adjacent St. Clement Danes, was discovered on the demolition of King's College Hospital in Portugal Street. He then concluded that little change had taken place in the physical characters of the Londoner during the last two or three hundred years, except that the skull showed a slight tendency to broaden.

Recent Excavation at Meare, Somerset

A FORTNIGHT's work of excavation at Meare Lake Village by Mr. H. St. George Gray and Dr. A. H. Bulleid has brought to light an interesting variant in the method of constructing their dwellings employed by the inhabitants. The season's work, as already indicated (see NATURE, Aug. 28, p. 352), is directed to the investigation of the central portion of the eastern half of the village. Excavation of the area surrounding Dwelling Mounds Nos. 16, 17 and 19, which, it is reported in *The Times* of September 13, has now reached the southern half of the floors of the circular dwellings, has shown that there are at least two floors, or layers of clay, separated by a quantity of ash, black earth and refuse deposited during the occupation. The peat in this part of the village is so firm that the usual timber foundations for the support of the clay floors appear to have been unnecessary. In the area surrounding the dwellings the refuse from the huts is found to contain a considerable amount of ornamented pottery (Iron Age "B") and evidence of weaving in the form of loom weights, spindle whorls and bobbins. Portions of bone needles also have been found. In the occupational refuse between the clay floors, the proportion of bones and pottery sherds found to the area at present examined is unusually high. The bones are mostly of lamb and young oxen, but there are also the remains of a small horse, pig and dog, a few bones of red and roe deer and also of birds. Here there is further evidence of weaving—spindle whorls of baked clay, stone and tin, bobbins, etc., as well as a highly polished bone needle and two bone pins with mouldings and long slots of a type unusual in western Britain. Objects of iron are not plentiful, but include a butcher's knife with convex edge. In bronze are a couple of fibulæ, an openwork harness ornament, and a hinge-plate with rivet holes. The ornaments include shale bracelets, and among the beads is one of blue, strung on a bronze wire.

Recent Earthquake in Sussex

SHORTLY after 1 a.m. on September 8, an earthquake of intensity 5 or more (according to the Rossi-Forel scale) was felt in the west of Sussex, especially at Horsham and the neighbouring village of Warnham. The earthquake is of some interest owing to its connexion with the series of shocks that have occurred for nearly three centuries in the district around Chichester, the first known to us being that of the year 1553. A little more than a century ago, between September 1833 and August 1835, there was a series of eight earthquakes in the district, which were studied by a small committee, the first ever instituted for the study of British earthquakes. One of the most important of these earthquakes was that of January 23, 1834. It was of about the same intensity as the recent shock. Its centre lay 4 miles west-north-west of Chichester, and the longer axis of its disturbed area of 780 sq. miles, if produced, passes through Horsham. Readers who are willing to aid in the investigation of the new earthquake should send their accounts to Dr. A. T. Dollar, Emmanuel College, Cambridge.

Mechanization in the Modern World

AMONG the matters handled at the meeting of the International Committee on Intellectual Co-operation at Paris on July 12–17 was the inquiry into mechanization in the modern world. The plan of this inquiry has been approved by the Committee and preparations are now in hand by the Institute. National lists of organizations concerned with social sciences are also being collected by the Institute, and lists have already been received from the United States, France, Japan, Italy, Czechoslovakia, Belgium and Norway. The inquiries on unemployment among intellectual workers are being pursued and the establishment of an advisory committee including representatives of the national bureaux and international organizations concerned has been authorized. The Institute has also collected most of the bilateral intellectual agreements in a volume which will shortly be published. The International Committee on Intellectual Rights has been concerned with preparations for the revision of the Berne Convention and for the Universal Conference on authors' rights, and a meeting of experts is being held to formulate final proposals for two conferences at Brussels on these subjects. The Advisory Committee of Intellectual Workers of the International Labour Office, however, pronounced in favour of keeping the question of the moral rights of salaried artists in the applied arts on its agenda.

The S.S. *Orcades*; the Latest Orient Liner

LAST month the Orient liner *Orcades* started on her maiden voyage. According to an article in the *Electrical Review* of August 27, it is claimed that she is the first British ship on the Suez route to have a public sitting-room supplied with conditioned air. Conditioned air is supplied to the public rooms and to several of the cabins. It is not sufficient for comfort to have only ventilation and correct temperature; the humidity must also be controlled within fairly narrow limits. In the tropics, the atmosphere is frequently uncomfortably damp. To reduce the temperature without extracting moisture from the air raises the relative humidity and may make the conditions more uncomfortable. When the climate is colder, air after warming sometimes becomes unpleasantly dry. Hence although air conditioning as it is managed at present is expensive, it may add greatly to the comfort and well-being of the passengers. The new vessel—an eight decker—has been built by

Vickers Armstrong for cruises and for service on routes between England and Australia. Its gross tonnage is 23,445 and it will accommodate 463 first-class and 605 tourist passengers and a crew of 466. Steam is provided by six oil-fired Babcock and Wilcox boilers. Pipes conduct it to two sets of 1,715 revs. per min. Parsons turbines. These drive the propellers at 112 r.p.m. by means of mechanical gearing. Two systems of intercommunication telephones are installed. The Marconi International Communication Co. has installed an all-wave radio installation, including a direction finder, and an 'echometer' depth sounder, together with a broadcast system of loud speakers throughout the vessel. Time is given by means of 82 synchronous clocks. A portable sound picture equipment by the Western Electric Co. is one of the many forms of entertainment provided.

The Problem of Dates of Publication

THE study of natural history has branched into many side-lines; but it is strange to think how far off the direct line of acquisition of nature knowledge the need for accuracy has led. For the convenience of naturalists the world over, animals and plants bear specific names, and the proper name where several have been given is determined conventionally by priority of christening. But so difficult is it in some cases to determine priority that an extensive literature has developed around these knotty problems, and so insistent is the demand for accuracy that a Society for the Bibliography of Natural History has been formed. The first part of its *Journal* is a catalogue of papers concerning the dates of publication of natural history books, arranged in alphabetical order of the authors of the books, and this ought to be of great service to systematists. Sometimes it is difficult to see exactly how the alphabetical order has been determined; "Ent. Soc. Lond." appears under "London", "Ent. Soc. N. S. Wales" under "Ent."; "Royal Phys. Soc. Edinburgh" appears under "Proc.", while the Wernerian Society of the same city appears under "Edinburgh". Doubtless there are sound reasons for this grouping, but they are not obvious, and they are not set out in the very brief introductory notes. The Society maintains a card index of papers concerned with the dates of publication of natural history books, and copies of such papers will be welcomed by the Secretary at 41 Queen's Gate, London, S.W.7.

Empire Grants Committee for Museums

THE final report to the Carnegie Corporation of New York on the activities of the Empire Grants Committee appears in the *Museums Journal* of May. It is a stimulating document. On April 1, 1934, the Committee was set up to administer a fund of 54,000 dollars granted by the Carnegie Corporation of New York for Colonial Museums, with an addition of 9,000 dollars for expenses, £12,550 in all. All museums in the British Colonies, and in Newfoundland and Southern Rhodesia were invited to submit applications for grants; forty applications were received and twenty-five grants were made. They ranged from £60 to Kandy Museum and Bermuda Historical Museum to £1,000 for Nairobi, Cyprus, Barbados, Singapore, Zanzibar, Jamaica. Various strict regulations had to be made as to the conditions upon which grants could be made; but the Committee is satisfied that the effect of grants has been in nearly every instance most stimulating to the local museum movement. At Bulawayo and Salisbury, the museums have been elevated to the dignity of national museums; in Cyprus, Barbados and Antigua more attractive premises and added Government recognition have been gained; but in most cases grants have been given for cases and equipment, so that museum interiors have been brightened and organized on modern lines. The success of the experiment leads the Committee to suggest that there are good reasons for continuing so promising a first effort.

Time Measurement

THE history and development of time measurement have already been described in a Science Museum Handbook ("Time Measurement", Part 1). The second part of the handbook which has recently been issued (London: H.M. Stationery Office. 2*s.* net) contains a detailed description of the objects in "The Time Measurement Collection at the Science Museum, South Kensington". The exhibits, ranging from the ancient Egyptian shadow clocks and water clocks to modern electric time-keepers, include sundials, mechanical clocks, watches and chronometers, escapement models and chronographs, as well as various auxiliary devices such as striking mechanisms, time recorders and time switches. Introductory remarks to each chapter explain the system of classification adopted, and outline the general principles involved in the respective groups of instruments. Many of the exhibits at the Science Museum are shown in continuous operation, while others can be operated by visitors—a facility that appears to receive perpetual appreciation. In addition, several of the more delicate watch mechanisms are illustrated by large-scale models. It may be noted that Harrison's four marine timekeepers (the fourth, completed in 1759, being the chronometer which won for Harrison the British Government prize of £20,000) are now represented in the Museum only by photographs, the originals themselves, long associated with the Royal Observatory, Greenwich, having been transferred to the National Maritime Museum at Greenwich. This handbook with its numerous illustrations provides an admirable introduction to a study of the Time Measurement Collection, and it will also serve as a useful handbook of reference for other occasions.

Meteorology in India

THE Meteorological Department of the Government of India has for several years had to contend with serious financial obstacles in the shape of reduced grants, when the increasing requirements of aviation have demanded increased departmental activity. The report on the Administration of the Meteorological Department of the Government of India in 1935–36 (Delhi: Manager of Publications, 1936) describes how various economies have been devised in order that the demands of aviation and other interests may be met so far as is possible. By taking full advantage of aeronautical wireless stations for the exchange of weather telegrams between aerodromes, and aided by cheaper telegrams, a saving of more than half a lakh of rupees annually has resulted. Economy was not made any easier by the disastrous earthquake of May 31, 1935, at Quetta, which demolished the Meteorological Office there, as well as the observers' quarters. This led to the pilot balloon station at Quetta being moved to Dera Ismail Khan for a time, and to the setting up of a temporary surface observatory at Quetta when the situation there was well enough in hand again. Research work did not slacken. Dr. T. Royds, director of the Kodaikanal Observatory, joined the expedition organized by the Royal Society and the Royal Astronomical Society to observe the solar eclipse of June 19, 1936. He took with him what is described as "perhaps the most powerful spectrograph ever used at an eclipse". The discovery of oxygen in the sun's chromosphere was announced from Kodaikanal in 1936 (see NATURE of April 11, 1936). Several pieces of research were carried out in the office at Poona with the voluntary aid of students guided by the official meteorologists. These included the development of a spectrograph for the study of ozone in the earth's atmosphere.

Activities of the Rockefeller Foundation

A REVIEW by its president, Mr. Raymond Fosdick, surveys the work of the Rockefeller Foundation during 1936. The expenditure totalled 11,300,000 dollars in connexion with its programme "to promote the well-being of mankind throughout the world". The agencies assisted included institutions, research work in medicine, biology and other sciences, and the humanities. Investigations on the jungle form of yellow fever and other health problems have been promoted, displaced German scholars have been helped, and appropriations have been made for trial work in the development of radio-programmes of cultural and educational value. A grant was given to the Orthological Institute in China for the preparation of a series of books for Chinese readers in 'basic' English.

Encke's Comet

A TELEGRAM from Copenhagen announces that Dr. Jeffers, Lick Observatory, has observed Encke's Comet. The position on Sept. $3 \cdot 38542^{d}$ U.T. was R.A. $2^{h}\ 19^{m}\ 4 \cdot 9^{s}$, N. Decl. 27° 10′ 20″. The magnitude is given as 18. In the "Handbook of the British Astronomical Association" for 1937, Dr. A. C. D. Crommelin gives an ephemeris based on an orbit in which perturbations of Jupiter and Saturn are taken into account. The observed position corresponds closely with that predicted by Dr. Crommelin.

Discovery of a Super-Nova in *Canes Venatici*

PROF. H. SHAPLEY has announced the discovery of a super-nova by Zwicky, and Humason found that it had a typical super-nova spectrum. Stobbe, at Kiel, gives its position as R.A. $13^{h}\ 2^{m}\ 57 \cdot 56^{s}$, N. Decl. 37° 57′ 19·2″, equinox 1937·0, and magnitude 8·7.

Announcements

A DEPARTMENT for psychology under the direction of Prof. E. R. Jaensch, director of the Institute of Psychological Anthropology at Marburg, has recently been added to the Imperial Leopoldine Caroline German Academy of Natural Science.

THE following awards have been announced by the North East Coast Institution of Engineers and Shipbuilders: The Institution Engineering Gold Medal to Harry Hunter, vice-president of the Institution, for a paper on "Singing Propellers"; M. C. James Medal to Mr. H. E. Lance Martin, head of the Civil Engineering Department at King's College (formerly Armstrong College), Newcastle-upon-Tyne, for a paper on "The Determination of the Residual Strains and Stresses in Arc-Welded Plates"; The Institution Scholarship, value £100, to R. A. Lyall, an apprentice of the Central Marine Engine Works, West Hartlepool.

THE board of Rolls-Royce, Ltd., has decided to found, in memory of Sir Henry Royce, a travelling research fellowship to be known as the Henry Royce fellowship. The Fellowship will not exceed £450 a year and will be tenable for one year, by a graduate of a British university or holder of the higher national certificate or other equivalent qualification. Research is to be concerned with the construction, design, materials, or methods of production of automobile transport, including applications to aircraft and modern engineering.

AN International Conference on Physics, Chemistry and Biology will be held in connexion with the Paris International Exhibition in the Palace of Discovery on September 30–October 9. The president will be Prof. Jean Perrin. Further information can be obtained from the General Secretary, L. W. Tomarkin, 11 Rue Pierre Curie, Paris, 5^e.

THE ninth Annual Conference of the National Smoke Abatement Society will be held at the Philosophical Hall, Leeds, on September 30–October 2. The programme includes discussions on town planning and smoke abatement, and education and smoke abatement. Further information can be obtained from the Secretary, Chandos House, 64 Buckingham Gate, London, S.W.1.

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of Rothamsted Experimental Station, Harpenden, Herts, and other members of the staff are available for giving lectures to interested institutions on the Rothamsted experiments. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 509.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Observations of the Solar Eclipse of June 8, 1937

A SCIENTIFIC expedition was organized early in the present year to observe the total solar eclipse of June 8 from somewhere on the coast of Peru, and the party of three sailed from Yokohama in the beginning of April. I was in charge, and arrived at Lima on May 10; after consultations with the Eclipse Committee of the University Mayor of San Marcos, I decided to have the observing station at Huanchaco, some 14 kilometres north-west of Trujillo. Two other members of the party, together with the instruments, landed at the port of Salaverry on May 20, and immediately proceeded to the station.

A large house of Sr. Victor Larco Herrera was kindly put at our disposal, where a large party of Peruvian scientific workers under Dr. G. Garcia was staying for the same purpose. Early in June, Dr. Clyde Fisher's American party also came to the same spot.

The main object of our party was to take large photographs of the inner corona with a ten-metre camera in conjunction with the 30-cm. cœlostat. Further, I had an independent set of cinematographic arrangements to get a rapid succession of photographs of three visible contacts, spectra of the flash and the corona, the extensions and the brightness of the corona. As the sun was about 9½° in altitude at the time of the eclipse, all instruments were set conveniently inside the rooms of the house and the sun could be observed through the available windows. A separate room was used for meridian observations of longitude and latitude made by me with a 38 mm. astronomical theodolite, the roof being taken away temporarily.

The weather was generally good during the interval of our stay at the camp, except for a few days in the very beginning of June when the skies were continuously overcast. The rehearsals and other preparatory work were well carried out.

On the day of the eclipse, the sky was overcast in the morning, but later it became clear and by 3 o'clock we had a perfect sky. The three visible contacts were observed as follows:

	1st Contact	2nd Contact	3rd Contact
Observed standard time	$16^h\ 15^m\ 29^s$	$17^h\ 18^m\ 20^s$	$17^h\ 20^m\ 57^s$
Corrections to computed time	+6	+3	+5
Observer	M. Horii	I. Yamamoto	I. Yamamoto

With the ten-metre camera, four plates were exposed for the partial phase and eight for the totality, with the exposures ranging from one tenth to 30 seconds. Upon developing, these plates have revealed splendid structures of the inner corona. My own cinematographic arrangements were partially successful, revealing good images only of the inner corona and the flash spectra.

According to these photographs, the coronal streamers are well developed around the sun. Especially in the north-east portion of the sun's limb there is a group of strong streamers and arches over a wide area, where daily observations of the sun's surface during previous weeks suggest an activity area of large sunspots. Characteristic rays from both the north and the south poles of the sun are completely hidden by strong coronal streamers. Hence the present corona is of the 'sunspot maximum' type.

There are about a dozen prominences visible around the sun. Two of them are magnificent, one in position angle 35° and the other in 290°.

I observed the longitude and latitude of our station on three nights. The preliminary result for the latitude is $-8°\ 4'\ 46{\cdot}6''$, but that of the longitude has not yet been reduced.

ISSEI YAMAMOTO.
(Director, Kwasan Observatory,
Kyoto Imperial University.)
Lima.
June 20.

Photo-conductivity and Phosphorescence of Zinc-blende

FROM early experiments on the photo-conductivity of zinc-blende, Gudden and Pohl[1] deduced that the current must be transported by two kinds of carrier, and according to present-day theory these must be electrons and 'positive holes'—vacant places left in a normally full electron energy band when an electron is ejected. While electrons are liberated by blue light, positive holes do not become mobile until a subsequent illumination by light of longer wavelength, for example red or infra-red, but the reason for this need not be discussed here.

The photo-induced conductivity is proportional to the intensity of illumination, which shows that electrons travel a finite distance (*Schubweg*) and are then 'trapped', the trapping *not* being in general due to recombination; for if it were, the current would be proportional to the square root of the illumination. The mechanism of this trapping need not concern us here; but either under infra-red illumination or thermal agitation the trapped electrons can be set free again. Trapping and re-liberation occur a number of times in succession, but the electrons finally come to rest by combining with a positive hole. The crystal is then said to be quenched.

That this is the case is shown by the way in which the conductivity dies away during quenching. If n is the number of electrons (a constant proportion of which will be in the conducting state), and also the number of holes, then if they are recombining their number will decrease according to

$$\frac{dn}{dt} = -c_1 n^2,$$

whence, integrating, we obtain

$$\frac{1}{n} = c_1 t + c_2,$$

c_1 and c_2 being constants. Thus we shall expect the resistance of the crystal to be a linear function of the time. This is confirmed by experiment. For example, Fig. 1 shows the resistance-time relation found during the quenching of a specimen by infrared light at – 196° C. It is seen that within the limits of experimental uncertainty the relation is linear.

It is interesting to note that phosphorescence decay data for zinc-blende obtained recently by Antonow-Romanowsky[2] are in full accord with these results, in that they show that the phosphorescence is due to a bimolecular reaction. It is easily seen that on the assumption that the intensity of phosphorescence, p, is proportional to the rate of recombination of electrons with holes, $p^{-1/2}$ should vary linearly with time. Plots of $p^{-1/2}$ against t, obtained from Antonow-Romanowsky's data, show that this is, indeed, the case. An example of such a plot is given in Fig. 2, in which the lower line is to be regarded as a continuation of the upper one, representing the points on the two reduced scales.

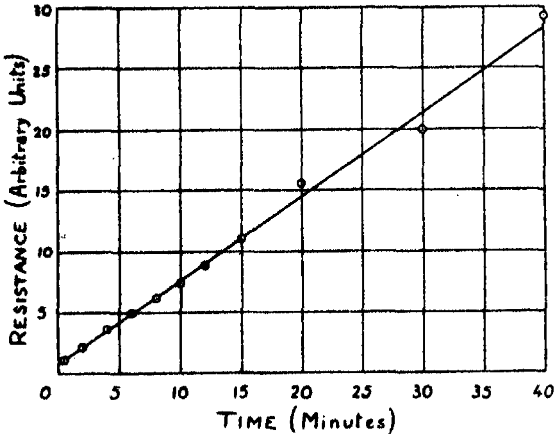

Fig. 1.

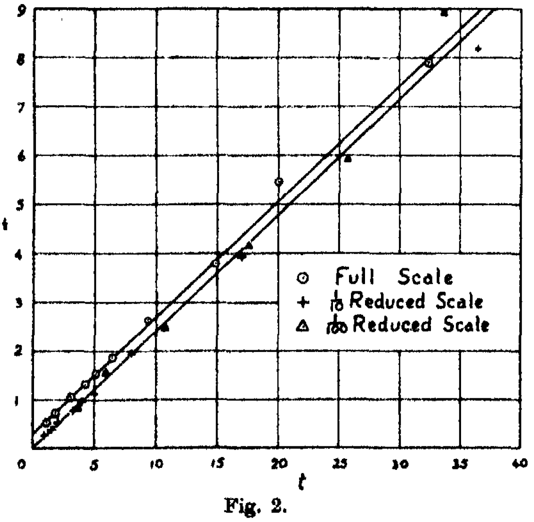

Fig. 2.

A. L. REIMANN.

Royal Society Mond Laboratory,
Cambridge.
August 18.

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[1] Gudden, B., "Lichtelektrische Erscheinungen" (Springer, 1928).

[2] Antonow-Romanowsky, W. W., *Sow. Phys.*, 7, 366 (1935).

Phosphine and Arsine Derivatives of the Group I(*b*) Metals: Volatile Derivatives of Gold

WE have shown that the trialkyl phosphine and arsine derivatives of cuprous iodide, previously considered to be $R_3P(As).CuI$, have a fourfold macromolecule[1], $[R_3P(As)\rightarrow CuI]_4$, and are therefore tetrakis—[iodo-trialkylphosphine (or arsine)-copper]. A complete X-ray examination of the triethyl-arsine member, $[Et_3As\rightarrow CuI]_4$, showed that the four copper atoms occupy the apices of a regular tetrahedron; the iodine atoms are situated each above the central point of one face of this tetrahedron, so that they also form a tetrahedron external to that of the copper atoms. Beyond each copper atom is an arsenic atom lying on the elongation of the axis joining the centre of the inner tetrahedron to the copper atom. The iodine atoms are thus 3-covalent, each being joined to the three neighbouring copper atoms apparently by one covalent and two co-ordinate links: if this is so, the stereochemistry of the 3-covalent iodine atom must be similar to that of 3-covalent sulphur, and the iodine atom can be regarded as occupying one apex of a tetrahedron with its valencies directed towards the other three apices.

The corresponding silver compounds have now been examined, and prove also to have the fourfold molecule, $[R_3P(As)\rightarrow AgI]_4$. These silver compounds have, moreover, the same constitution as the cuprous compounds, since $[nPr_3As\rightarrow AgI]_4$ is strictly isomorphous with $[Et_3As\rightarrow CuI]_4$. This is a remarkable example of isomorphism, the effect of the replacement of the copper by silver atoms being compensated by the replacement of the ethyl by the n-propyl groups. It follows that both the 4-covalent cuprous and argentous atoms have a tetrahedral configuration, in confirmation of the results obtained by Cox, Wardlaw and Webster[2].

The aurous compounds, $[R_3P(As)\rightarrow AuX]$, where X is a chloride, iodide or thiocyanate radical, prove, however, to be monomolecular, and the gold thus shows a true co-ordination number of 2. The phosphine compounds, $[R_3P\rightarrow AuX]$, where X is Cl or I, possess remarkable stability, and can be freely distilled under reduced pressure. The compound $[nBu_3P\rightarrow AuCl]$ can be volatilized even at atmospheric pressure, and the vapour, if passed through a heated tube, deposits a fine film of gold. There are thus two distinct chemical methods of producing gold films, the first having been recently described by Prof. C. S. Gibson in NATURE of August 14 (p. 279).

It is noteworthy that, whilst the copper and silver atoms both acquire 7 electrons in the above compounds and thus attain the electronic structure of the next inert gas, the gold atoms acquire only 3 electrons and thus remain 4 short of the radon structure. The gold in these compounds, however, falls in line with mercury, which acquires 2 electrons in compounds such as HgR_2 and $Hg(SR)_2$[3], and with thallium, which acquires 1 electron in compounds such as $[TlR_2]X$, a group of 4 shared electrons in the sixth quantum group allowing considerable stability in all three cases.

F. G. MANN.
A. F. WELLS.

University Chemical and
Crystallographic Laboratories,
Cambridge.
August 19.

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[1] Mann, Purdie and Wells, *J. Chem. Soc.*, 1503 (1936).

[2] Cox, Wardlaw and Webster, *J. Chem. Soc.*, 775 (1936).

[3] Mann and Purdie, *J. Chem. Soc.*, 1549 (1935); Wells *Z. Krist.* 96, 435 (1937).

Behaviour of Cylinders of Inflammable Gas in a Fire: Extinguishing Flames by Coal Gas

ON the night of October 5, 1936, a fire occurred in Pearse Street, Dublin, in a shop which housed two full cylinders of compressed gas, one containing 150 cu. ft. of oxygen, the other 100 cu. ft. of coal gas. In each case the internal pressure was 120 atm. During the fire explosions took place, and a large portion of the building collapsed. It was found afterwards that three firemen had lost their lives. A Tribunal of Inquiry, appointed by the Minister for Local Government and Public Health of Saorstát Éireann, has recently issued its report (Stationery Office, Dublin). "The Tribunal is satisfied that the explosions must be attributed to the two full cylinders of coal gas and oxygen," and includes among the results of the explosions "the trapping of three firemen who were then within the building thereby causing their deaths".

The fire, and the inquiry which followed, raise a point of general interest. If a fire occurs in premises in which cylinders of compressed gas are stored, will that fire be likely to be much more disastrous than if cylinders are absent?

In the present instance, there is no doubt that the cylinders burst in the course of the fire, for they were found ruptured in the ruins. There was general agreement, however, that the result of the physical bursting of a cylinder of compressed coal gas, followed by the *burning* of its contents, was likely to be much less disastrous than if the contents of the cylinder became mixed with air and suffered chemical *explosion*.

The men of science who attended the inquiry as expert witnesses found themselves faced with the following problem. Suppose the back of the shop (where the coal gas cylinder was placed) in flames, and suppose the front of the shop not yet on fire. The coal gas cylinder bursts, presumably in the midst of the flames. Could the gas (if the burst took place on the suitable side of the cylinder) make its way through the flames into the air in the front part of the shop, form an explosive mixture, and explode if a flame reached the mixture before it had become too dilute?

There is no doubt that the emerging coal gas could extinguish the flames in immediate contact with the cylinder. Intense cooling (in this instance 500°–600° C.) would result from an almost adiabatic expansion. Further, the concentration of combustible material would far exceed the upper critical explosion limit, which is about 28 per cent of combustible in the case of Dublin coal gas. I expressed the opinion that the jet of coal gas, shot with high velocity from the ruptured cylinder, might thus extinguish the flames in its path, and blast its way through the surrounding fire to the air in the front of the shop, where chemical explosion would probably follow. The alternative picture submitted was that of the coal gas swelling out of the ruptured cylinder as a 'balloon' which would *necessarily* be kindled at its periphery. It would then make its way to the nearest outlet as a gigantic flame, prevented by a mantle of burnt gases from mingling with air so as to form an explosive mixture.

The essential problem is therefore: Can a jet of coal gas extinguish flame *without itself being ignited?* If the answer is in the affirmative, there exists a possibility of *chemical* explosion in a case such as the present. Whether explosion actually occurs will depend on a variety of factors, such as the volume and pressure of the escaping combustible gas, and the extent of the fire by which the container is surrounded.

I have carried out experiments, which I believe to be new, showing that coal gas *can* extinguish flame without itself being ignited.

A coal gas flame, five or six inches high, was established in the open air. A small cylinder of compressed coal gas (20 cu. ft.), fitted with the usual *nozzle to control the rate of discharge*, was used. The nozzle was opened full and the stream directed, from a distance of 3–4 ft., on to the flame. After a little practice, one was able to extinguish the flame without igniting the stream of gas from the cylinder.

A less striking experiment was carried out as follows. A five-litre flask was filled with coal gas, and the mouth covered with thin paper to form a temporary barrier to the gas. The flask was adjusted, mouth downward. A small gas flame was prepared. The tube from which this gas issued was surrounded at the mouth by a short piece of wider glass tubing with irregular edges, to puncture the paper before the flame reached it. The edge of the wider tubing was only just above the level of the top of the flame. When the flame was pushed up into the flask of gas, it was of course extinguished. The gas which issued from the flask sometimes took fire, but on numerous occasions the flame was extinguished without igniting the gas.

KENNETH C. BAILEY.

Trinity College,
Dublin.
August 12.

Formation and Breakdown of Amino-acids by Intermolecular Transfer of the Amino Group

WE have previously reported[1] the discovery in muscle of a highly active metabolic mechanism, by the action of which the amino group and two hydrogen atoms of glutamic acid are transferred to pyruvic acid (added or of metabolic origin) with the formation of alanine (and ketoglutaric acid). This is the key to the puzzling fact that glutamic acid is transformed into succinic acid by muscle tissue without the formation of either ammonia or amide nitrogen (D. Moyle-Needham).

Further work, to be published in detail elsewhere, showed this reaction to be a reversible one. From alanine and α-ketoglutaric acid muscle tissue rapidly forms glutamic and pyruvic acids, equilibrium mixtures of similar composition resulting in both the direct and the reversed reaction.

The presence of the enzyme system responsible for this process of *Umaminierung* can be readily demonstrated not only in muscle, but likewise in other organs (heart, brain, liver, kidney), irrespective of their capacity or inability to metabolize amino-acids by oxidative deamination or reductive amination respectively. In organs containing Krebs's aminodehydrogenase the intermolecular transfer of the amino group competes with oxidative deamination and, owing to its greater velocity, completely inhibits the latter process in the presence of an excess of pyruvic acid. Only with nucleated erythrocytes and malignant tissues no evidence of *Umaminierung* has been obtained up to the present.

α-Ketoacids other than pyruvic, for example, α-ketobutyric, α-ketocaproic, oxaloacetic or phenylpyruvic acid, may equally serve as acceptors for the amino group of glutamic acid. On the other hand, all α-amino acids readily give up their amino groups to α-ketoglutaric acid in the presence of muscle tissue; the formation of glutamic acid has been demonstrated with sixteen different natural and racemic amino-acids including such as glycine or histidine, known to be difficultly accessible to oxidative deamination by surviving tissues. The rate of *Umaminierung* is astonishingly high; thus, no less than 6·5 mgm. glutamic acid is formed in two minutes from glycine and ketoglutaric acid by one gram of muscle tissue. This would correspond to a value of $Q_{Umam} = 152$. In our opinion, the mechanism of this biocatalytic reaction is the same as that discussed by Herbst[2] in recent studies on a somewhat similar model reaction, occurring when amino-acids are heated with ketoacids in aqueous solution.

Aspartic acid behaves in the same way as glutamic acid (Kariagina, this laboratory), and oxaloacetic acid —as ketoglutaric acid, in the function of amino nitrogen *donators or acceptors respectively*. The 'trapping' of oxaloacetic acid by the acceptance of amino groups, interfering with the action of Szent-Györgyi's "fumarate system", offers an adequate explanation for the inhibitory effect of amino-acids on the respiration of muscle and other non-deaminizing tissues, repeatedly observed by different authors. An attractive hypothesis on the origin of diabetic ketosis was recently put forward by Koranyi and Szent-Györgyi[3], who consider this condition as a result of damage to the fumarate system, possibly brought about by *Umaminierung* or a similar mechanism.

It deserves special attention that no transfer of the amino group occurs unless either the amino-acid or the ketoacid is a dicarboxylic one. No instance of a direct amino nitrogen transfer between two monocarboxylic acids has yet been observed, but some evidence has been obtained showing that the reaction can be brought about by the catalytic action of dicarboxylic amino- or ketoacids, added in small amounts and functioning as intermediary amino nitrogen carriers. The above data indicate that the dicarboxylic amino- and ketoacids probably play an important and specific part in the intermediary nitrogenous metabolism, bearing some analogy to the catalytic function of the C_4-dicarboxylic acids in tissue respiration.

A. E. BRAUNSTEIN.
M. G. KRITZMANN.

Laboratory of Oxidation-Reduction Processes,
Department of Metabolic Research,
All-Union Institute of Experimental Medicine,
Moscow. July 25.

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[1] *Bull. Biol. et Med. Exper., Moscou*, **8**, 230 (1937). *Biochimia*, **2**, 242 (1937).

[2] Herbst and Engel, *J. Biol. Chem.*, **107**, 505 (1934). Herbst, *J. Amer. Chem. Soc.*, **58**, 2239 (1936).

[3] Koranyi und Szent-Györgyi, *Deutsch. Med. Wochenschr.*, No. 27 (1937).

Meteorites: the Number of Pultusk Stones, and the Spelling of "Widmanstätten Figures"

(1) IN NATURE of July 17, Dr. Stenz[1] expresses the opinion that not more than 3000 stones fell near Pultusk in the famous meteorite shower of January 30, 1868, and that only a curious misreading of a chemical analysis led to the usually quoted number of 100,000 stones.

The Pultusk fall is of special interest, being one of the very few—six or seven—cases in which the orbit of a meteorite could be calculated; according to the astronomer Galle[2], for the Pultusk stones a hyperbolic velocity, hence an extrasolar origin, is proved. Furthermore, from the acoustic and optical phenomena of the fall he concluded that the stones were not fragments produced by an "explosion" in the atmosphere, but had already entered the solar system as a shower. The question as to their approximate number is, therefore, of some importance, and it may be permissible to quote a few statements from the literature which seem clearly to contradict Dr. Stenz's drastic reduction of the figure.

The well-known Bonn mineral dealer, Dr. A. Krantz, procured 34 kgm. of the stones[3]. He ascertained that 1 kgm. contained some 210 stones with a perfect crust[4], this being proof that all the stones he counted had fallen as separate units, although some did not weigh more than a gram. It follows that this one dealer possessed more than 7000 stones, that is, more than twice the number Dr. Stenz ascribes to the whole fall. Altogether 200 kgm. were secured[3], representing—on the basis of Dr. Krantz's statistics—some 42,000 stones. In the shower the smaller stones were obviously more numerous than one would infer from some collections, for which the bigger ones were preferred; but, for example, Dr. Melion's description of the 125 Pultusk stones in his possession[5], of a total weight of 1150 gm., shows still the marked preponderance of the small type (86 stones of less than 7 gm.).

Now, considering that in the shower of stones the *majority only weighed a few grams—the so-called* "Pultusk peas"—and that the fall covered an area[6] of 17 km. × 6 km. of rough and partially flooded land[7], the assumption that the total number was two or three times the number of stones recovered is very conservative. Vom Rath[4] even thinks it possible that several hundred thousand stones fell. There is certainly no reason to change the usually quoted round figure of a hundred thousand for the 3000 of Dr. Stenz.

One gram was apparently the smallest mass anyone in the Pultusk area called a "stone" and thought worth picking up, but Galle[2] may be right in assuming in the original shower the presence of "innumerable" smaller particles.

(2) For more than a century the well-known etching-patterns on iron meteorites have been called "Widmanstätten figures", after their discoverer, Alois von Widmanstätten (1754-1849). He, however, personally published nothing on the subject, but left this duty to his friends. Four years ago, Dr. Spencer[8], in a very thorough survey of meteorite literature, showed that the spelling of the name Widmanstätten was not consistent, the "tt" sometimes being replaced by "dt", the "ä" by "e", and so on, and stated that all the various forms hitherto used are wrong, the correct spelling of the family name being Widmanstetter. Following Dr. Spencer, writers on meteorites in Great Britain and abroad[9] begin to speak of "Widmanstetter figures".

It is certainly no use trying to decide whether "tt" or "dt", "ä" or "e" is the more correct spelling of an Austrian name of a hundred years ago; as these differences are not audible in pronunciation, both ways of writing were then considered as equivalent. The "r" instead of "n" at the end of the name is a somewhat more serious difference. A study of the history of this particular family shows that for decades both forms occurred; but Cohen, who was already aware of this discrepancy, on the authority of Wurzbach's dictionary[10], declares in his "Meteoritenkunde"[11] that the discoverer of the etching-figures himself usually wrote "Widmanstätten" and therefore this form ought to be chosen. In view of Dr. Spencer's publication, I asked friends in Vienna and Graz to inquire anew about the form of the name personally used by the scientist. They went rather fully into the question and completely confirmed Wurzbach's and Cohen's statement. Official documents are still preserved which mention Alois von Widmanstätten as the owner of a house in Graz, as the inventor of a balance, etc.

Keepers of meteorite collections may be glad to learn that there is, therefore, no reason to alter the hundreds of labels bearing the name Widmanstätten.

F. A. PANETH.

Imperial College of Science and Technology,
London, S.W.7.
August 5.

[1] Stenz, E., NATURE, **140**, 113 (1937).

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[3] Wülfing, E. A., "Die Meteoriten in Sammlungen", p. 287 (Tübingen, 1897).

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Response of the Pigeon Crop Gland to Prolactin: Inhibition by Œstradiol Monobenzoate

Riddle and Braucher[1] showed that injections of the hypophyseal lactogenic hormone, prolactin, discovered by Stricker and Grueter[2], will cause growth of the crop glands of the pigeon. In view of the fact that established lactation is inhibited by administration of œstrogenic hormones[3,4,5], it is of considerable interest to determine whether or not simultaneous administration of œstrogens will affect the response of the pigeon crop to prolactin injections.

Two groups of 24 young pigeons of 'homer' type were used. Each bird was given six daily subcutaneous injections of 1 ml. of a solution containing 5 mgm. of prolactin. For the gift of this material, which was prepared by the method of Bates and Riddle[6], omitting the final purification, we are indebted to Dr. F. G. Young. In addition, on the fifth day before the commencement of the prolactin injections one group was given injections of 1 ml. progynon B oleosum forte (kindly supplied by Dr. H. Neumann of Messrs. Schering, Ltd.) containing the equivalent of 5 mgm. œstradiol monobenzoate in sesame oil, followed by similar injections on the day of commencement of prolactin treatment. The other (control) group received equivalent injections of sesame oil alone. Twenty-four hours after the last injection the birds were killed and weighed. The sex of each was determined and the crop glands dissected out, fixed in Bouin's fluid and weighed from 70 per cent alcohol after pressing in muslin. The mean weights of the crops in mgm. per 100 gm. of body weight at killing are given in the accompanying table, the results for the two sexes being given separately. The crop gland region in the normal pigeon usually weighs about 300 mgm. per 100 gm. body weight.

	Male		Female	
	No. of birds	Mean crop weight in mgm. per 100 gm. body weight	No. of birds	Mean crop weight in mgm. per 100 gm. body weight
Œstradiol monobenzoate	9	680 (±67)	15	830 (±50)
Sesame oil	7	1490 (±103)	17	1080 (±47)

The figures given in parentheses are probable errors of the means against which they are entered.

In both sexes administration of œstradiol monobenzoate caused a marked inhibition of the crop gland response, the mean inhibition amounting to about 54 per cent in the males ($P = 1:2{,}500$)* and about 23 per cent in the females ($P =$ about $1:40$).

This difference between the sexes in the degree of inhibition (sex-difference statistically significant at $P = 1:140$) is for the most part accounted for by the fact that in this experiment the reaction of the control birds to prolactin + sesame oil was significantly greater in males than in females ($P = 1:180$), while in the group receiving œstradiol monobenzoate the difference between the responses of the two sexes was negligible.

It is noteworthy that the group receiving œstradiol monobenzoate lost on the average 7·7 per cent of body weight in the course of the experiment ($P = 1:90$), although the control group gained on the average 6·7 per cent ($P = 1:210$). In both groups the mean change in body weight was somewhat greater in the females than in the males.

Since the prolactin response of hypophysectomized pigeons appears to be either nil[7] or considerably less than that of intact birds[8] it is possible that œstradiol monobenzoate inhibits the response by way of the pituitary.

S. J. FOLLEY.

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Research in Dairying.

PAUL WHITE.

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Aug. 3.

* P = Probability that an effect at least as great as the observed effect should have arisen purely as an accident of random sampling. See Fisher, R.A., "Statistical Methods for Research Workers" (1934), Edinburgh and London, chap. v, *passim*.

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Some Interrelations between Bivalve Spatfalls, Hydrography and Fisheries

IN a study of the intensity and distribution of spatfalls of *Cardium edule* on the Cark sands in Morecambe Bay, it was found that the heaviest falls occur (*a*) where tidal streams meet—such localities being described locally as 'meetings'—and (*b*) where banks shelter a stretch of ground from prevailing winds. The heaviest falls occur at about the half-tide level.

The fall of spat is contemporaneous with considerable depositions of fine sand intermingled with some detritus, and larvæ and post-larvæ of various other organisms such as *Polydora*, *Macoma*, other bivalves and worms. Such settlements form a densely populated mud or slutch. The same phenomenon occurs in the Dee estuary. In winter the slutch disappears.

It is clear that the *Cardium* and other organisms become concentrated and precipitate out of the plankton in localities where slack and eddy waters occur. As many as 100,000 young *Cardium* per square metre may occur in the centre of such areas[1], with diminishing concentrations towards the periphery of the meetings and low values outside them.

Recognition of these conditions at once suggested comparison with those found by Davies[2] on and near the Dogger Bank. Here concentrations of the fish-food, *Spisula truncata*, up to 8,250 per square metre occurred in the centre of elongated or ovoid areas, with diminishing numbers to the periphery in each case. This distribution resembles that of *Cardium* and other organisms in Morecambe Bay, and it was suspected might be brought about in a similar way, namely, by the concentration of the planktonic forms in eddying waters over and around the Dogger Bank. Recently Tait[3], in investigating the surface drift of water in the North Sea, finds stream currents giving rise to eddies or swirls in several localities, including one on the north-east of the Dogger Bank. This eddy practically overlies the part of the Dogger Bank where Davies found the great spatfalls of *Spisula*.

There can be little doubt that immense quantities of larval fish foods in the form of bivalves and worms become concentrated in these swirls or eddies. Where sub-surface conditions are suitable as over the Dogger Bank, in the Moray Firth, in the mid-east Scottish coast and other areas, the larvæ settle out of the plankton to form rich feeding grounds for fish. We have therefore now a rational explanation of how such grounds are formed, and a clear indication of where to find them. On natural oyster beds oyster larvæ also tend to settle most frequently (*a*) where eddies form, as at the junction of a side stream with the main one, as well as in eddies formed along the shores of the main channel, and (*b*) in other regions of relatively still water[4].

In the recent planktonic studies in the south-western North Sea by Savage and Hardy[5] and Savage and Wimpenny[6], only the area of the drift west and south-west of the Dogger Bank was investigated, and it is a reasonably safe prediction that an immensely rich planktonic area remains to be discovered in the eddy over the north-eastern region of the Dogger Bank. This eddy is not stationary, so that spatfalls may settle out in different but adjacent places, as is apparent from Davies's justifiably painstaking research. These spatfalls indicate, moreover, that the eddy over the Dogger Bank may extend sometimes from the surface into deeper water—probably during certain sets of tides when bivalve larvæ are ready to settle—or may enclose a body of relatively still water at all depths.

J. H. ORTON.

Department of Zoology,
University of Liverpool,
August 14.

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[6] Savage R. E., and Wimpenny, R. S., *Fish Invest., Min. Agric. and Fish.*, II, 15, 1 (1936).

Consumption of Oxygen in Sea Water under Controlled Laboratory Conditions*

DURING a recent hydrographical cruise of the *Atlantis*, the oxygen consumption in samples of water taken from eighteen levels between surface and 4,600 metres depth at Station 2886 (32° 19′ N., 65° 59′ W.; June 19, 1937) was determined under controlled laboratory conditions. Two glass bottles (with ground-glass stoppers) were filled from each of the Nansen water bottles as soon as they were brought on deck; one set of eighteen samples was stored at a temperature of 11° in an electric refrigerator and the other set at a temperature of 24° in the laboratory. After ten days of storage in darkness, oxygen contents of the two sets of samples were determined and subtractions of these values from initial oxygen contents of the samples gave results we have termed oxygen consumption.

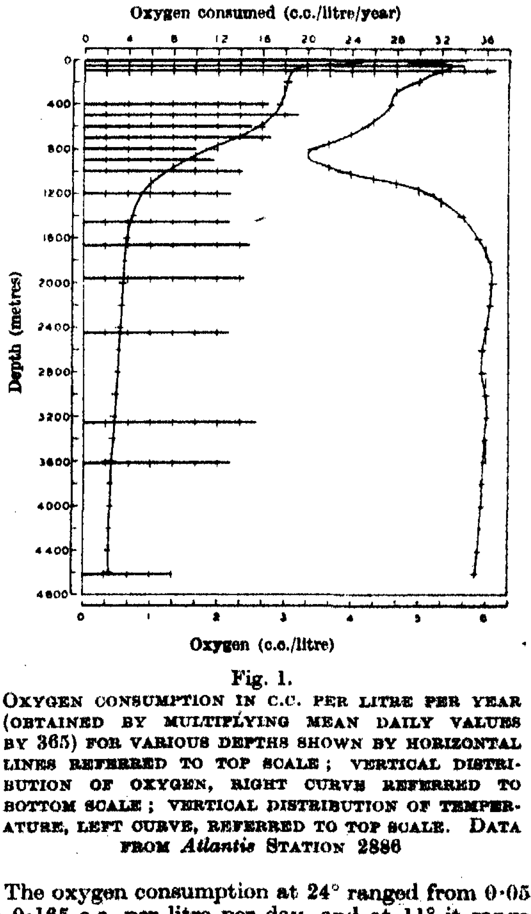

Fig. 1.

OXYGEN CONSUMPTION IN C.C. PER LITRE PER YEAR (OBTAINED BY MULTIPLYING MEAN DAILY VALUES BY 365) FOR VARIOUS DEPTHS SHOWN BY HORIZONTAL LINES REFERRED TO TOP SCALE; VERTICAL DISTRIBUTION OF OXYGEN, RIGHT CURVE REFERRED TO BOTTOM SCALE; VERTICAL DISTRIBUTION OF TEMPERATURE, LEFT CURVE, REFERRED TO TOP SCALE. DATA FROM *Atlantis* STATION 2886

The oxygen consumption at 24° ranged from 0·058 to 0·165 c.c. per litre per day, and at 11° it ranged 0·020 to 0·069 c.c. per litre per day; higher values characterized water from levels below 1000 metres depth. The average oxygen consumption of all eighteen samples incubated at 24° was 0·1224 c.c. per litre per day, and for those at 11° it was 0·0487 c.c. per litre per day.

In an attempt to estimate what the oxygen consumption would have been if the samples of water had been incubated at their respective observed temperatures *in situ* (Fig. 1), it was assumed that the variation in oxygen consumption with temperature (between 25° and 2°) was of the form :

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* Contribution No. 151 from the Woods Hole Oceanographic Institution.

$$(1) \qquad \ln k = c - \frac{A}{T};$$

which equation after being differentiated and then integrated between the limits k_1, T_1, and k_2, T_2 results in a form of the Arrhenius equation :

$$(2) \qquad \ln \frac{k_1}{k_2} = \frac{Q}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right),$$

which frequently represents in a satisfactory manner the effect of temperature on biological reactions over limited temperature ranges.

Upon determination of the constant Q (R is the gas constant) from the average consumption values at 24° and 11°, each of the 18 pairs of values obtained at these temperatures were reduced by means of the Arrhenius equation to values corresponding to observed temperatures (range 25°–2°) at the depths from which the samples were taken, and the means of each pair of values (after multiplying by 365) are plotted against depth in Fig. 1. It is realized that this method of extrapolation may not hold for this particular phenomenon over the entire temperature range of 25° to 2°, but it does furnish an approximation.

The results (Fig. 1) after reduction are too high, particularly in the deeper levels, to be used in estimating oxygen consumption *in situ* in the water column itself. For example, at Station 2886, water from the minimum oxygen layer (less than 60 per cent saturated, occurring approximately between depths of 700 and 1000 metres) had an average daily adjusted oxygen consumption of 0·0363 c.c. per litre, which is about 32 times greater than the value of 0·42 c.c. per litre per year previously estimated for this layer; and water from between 1000 and 2000 metres had an adjusted daily consumption in the laboratory of 0·0385 c.c. per litre, which is more than 100 times greater than the more reasonable previously estimated value of 0·103 c.c. per litre per year for this part of the water column.

Thus, it appears that conditions in the sea, other than temperature, restrict the rate of oxygen consumption, and the above results are of interest since they indicate the potential rates of oxygen consumption throughout a water column of the sea when its equilibrium is disturbed by laboratory conditions.

H. R. SEIWELL.

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August 2.

Role of Heteroauxones in Legume Nodule Formation, Beneficial Host Effects of Nodules, and Soil Fertility

FOLLOWING identification of β-indolacetic acid[1] as a constituent of ether extracts of cultures of *Rhizobium phaseoli* in dextrose-bacto-tryptophane and in dextrose-bacto-tryptophane-peptone broths, these crude extracts were tested for auxones by applications to coleoptiles of *Avena*, and to hypocotyls and internodes of *Phaseolus vulgaris*, var. Red Kidney. The tests were strongly positive. Thus far we have been unable to determine whether β-indolacetic acid is the only heteroauxone in the preparations because of the scarcity of material.

Further, extraction of nodules of spontaneously infected Red Kidney bean plants first with acidulated 95 per cent alcohol (in which the nodules were ground with pumice) and then with peroxide-free ether has yielded preparations which feebly affect growth of coleoptiles of *Avena* and of hypocotyls and internodes of the Red Kidney bean. Thimann's[2] method of extraction with acidulated chloroform probably will reveal a higher auxone content. Possibly the lot of nodules extracted was too old on the average to give a maximum auxone yield and possibly the sample used (50 gm.) was too small. Work is under way with larger and younger samples and with other methods of extraction. Tests with ferric chloride, hydrochloric acid and amyl alcohol indicate β-indolacetic acid as a nodular constituent. Unfortunately, the test is made with difficulty and uncertainty because of the dark colour of the crude extracts. Until more material and better tests are available, it will be impossible to identify β-indolacetic acid more positively or to determine whether the extracts contain growth substances other than β-indolacetic acid.

In conjunction with our findings[1] that pure β-indolacetic acid, applied in different concentrations and amounts in lanolin paste to primary roots of Red Kidney bean induces: (1) positive bending; (2) coiling; (3) retardation or suppression of root elongation; (4) premature and excessive lateral root initiation; (5) local diameter increase and nodulation, and with Thimann's[3] findings that pea nodules are hyperauxonic in relation to normal healthy pea roots and that β-indolacetic incites nodulation in roots of *Pisum sativum*, our new findings indicate that β-indolacetic acid is one of the chemical agents, if not the agent, responsible for incitation of nodulation in susceptible hosts by *Rhizobium phaseoli* and other nodule-forming organisms.

The relative yields of total crude extracts from equal weights of nodules and of healthy roots as well as the greater growth-affecting capacity of the former, indicate hyperauxony for the nodules. These observations, together with Thimann's[3] report that nodules of pea have a greater auxone content than non-infected root tips of the pea, seem to support the hypothesis[1] that tumours (including callus and galls) are brought about by local hyperauxony. This may be due to autoauxones, to heteroauxones, or to both added to the normal autoauxone content.

Coupled with our earlier findings[1] that β-indolacetic acid applied experimentally to the bean may augment or be in part a substitute for its autoauxones, the results reported here suggested the hypothesis that the beneficial effects of suitable concentrations of β-indolacetic acid and other auxones acting as heteroauxones may account in part for the characteristically beneficial effects of: (1) nodules for some host plants; (2) green manuring with nodule-bearing plants; (3) fertilizing with manures rich in dung and urine, or with compost; (4) humus soils; and (5) mycorrhizal fungi for some host plants.

This research was supported in part by a grant from the Rockefeller Foundation to the University of Chicago. Miss Virginia Eggers executed the growth tests. Prof. F. C. Koch kindly permitted use of space and equipment of his biochemical laboratory for execution of the extractions.

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July 29.

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[2] Thimann, K. V., *J. Gen. Physiol.*, **18**, 23–34 (1934).

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Structure of a New System of CO Bands

In a previous note[1] the discovery of a new system of red-degraded CO bands, placed just before the heads of the violet-degraded Third Positive system, was reported. Inspection and measurement of high-dispersion spectrograms now show that the new bands have a structure appropriate to a $^3\Sigma\rightarrow{}^3\Pi$ band-system, the lower state being the $a^3\Pi$ state, which is the usual final state of the CO triplet systems. The upper $^3\Sigma$ levels of the new bands lie about 83705 cm.$^{-1}$ and 85885 cm.$^{-1}$ above the CO ground state; they have observable spin-splittings and rotational constants $B' = 0{\cdot}7$ to $0{\cdot}8$ cm.$^{-1}$. The system may tentatively be designated as $f^3\Sigma\rightarrow a^3\Pi$. It may be considered, however, as probably due to transitions from the higher vibrational levels of $a'^3\Sigma$ to the lower vibrational levels of $a^3\Pi$. For, within the heights of the initial levels $f^3\Sigma$ of the new bands occur also the initial levels $b^3\Sigma$ of the Third Positive bands, and the latter are strongly perturbed, as has already been established[2], by vibrational levels of the $a'^3\Sigma$ state, for which we have predicted term values and rotational constants of the magnitude now observed for the new bands.

Rotational analysis and details will be published shortly elsewhere.

R. Schmid.
L. Gerö.

Physical Institute,
Royal Hungarian University,
Budapest. July 31.

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[1] Schmid, R., and Gerö, L., *Naturwiss.*, **25**, 90 (1937).

[2] Schmid, R., and Gerö, L., *Z. Phys.*, **105**, 36 (1937) **106**, 205 (1937).

L-Emission Bands of Zinc, Copper, Nickel and Cobalt

I have studied the intensity of the *L*-emission bands of metals from Co (27) to Zn (30). The apparatus used was a vacuum spectrograph using a bent crystal of mica, and the source of the radiation was an X-ray tube.

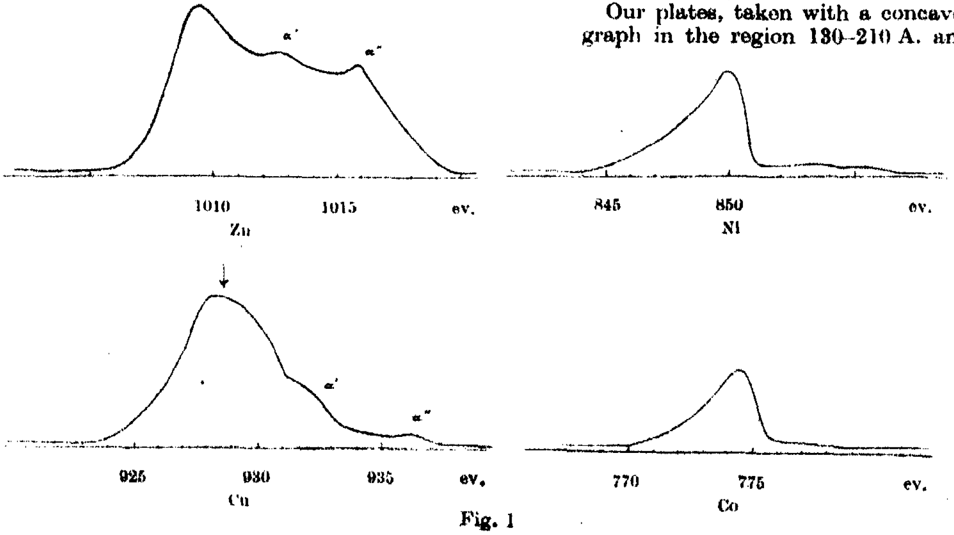

Fig. 1

To obtain the actual intensity distribution of the emitted radiation, the plate was calibrated by a method already described[1]. The curves giving the intensity of the L_α bands against energy (in electron-volts) are shown in Fig. 1.

It is well known that the *L*-emission bands are emitted when $M_{\rm IV,\,V}$-electrons make transitions into the $L_{\rm II,\,III}$-levels ($L_{\alpha_{1,2}}$ and (L_{β_1}). There are also transitions of $N_{\rm I}$-electrons into the $L_{\rm II,\,III}$-levels. For these metals the $N_{\rm I}$- or 4*s*-electrons are the conduction electrons, and occupy levels which overlap in energy those of the $M_{\rm IV,\,V}$- or 3*d*-electrons.[2] Thus the observed bands represent transitions of both 3*d*- and 4*s*- electrons. But for copper and zinc, unfortunately, the short wave-length ends of the bands, which are probably due to the 4*s*-electrons, are completely masked by satellites, which are strongly enhanced by the reorganization of the atom on account of the Auger effect[3], $L_{\rm I}$–$L_{\rm III}$.

The position of the short wave-length edge of the L_α-bands may be estimated from the *L*-absorption spectra, and is given by the wave-length of the slope of the absorption curve near the minimum absorption. For copper, we can deduce from the absorption curve of Sandström[4] that the edge of the L_α-emission band is given by the arrow marked on Fig. 1. From the comparison of the *L*-emission and absorption bands it is obvious that the width of the L_α-band is about 5 ev.

J. Farineau.

Université, Liége.
Aug. 3.

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[1] *Comptes rendus*, **204**, 1242.

[2] See Mott and Jones, "The Theory of the Properties of Metals and Alloys" (Oxford, 1936), p. 191.

[3] See Coster and Kronig, *Physica*, **2**, 13 (1935).

[4] Sandström, A., Thesis, Uppsala (1935).

M-Emission Bands of Zinc, Copper and Nickel

We have had the opportunity of seeing Dr. Farineau's letter before it was sent to press. We have recently observed the *M*-emission bands of nickel, copper and zinc metals, and it seems worth while to add a note, since the two sets of results, especially taken together, allow one to draw certain conclusions about the structure of the 3*d*- and 4*s*(conduction)-electron bands in these metals.

Our plates, taken with a concave grating spectrograph in the region 130–210 A. and with an X-ray tube run at 3,000 v. as source, give results which, on a scale of energy, are almost identical with Farineau's *L*-emission bands. This is good evidence that, apart from transition probability factors, the curves represent features of the density-functions of the combined 3*d*-conduction-levels of the metals. We also obtain for zinc and copper the peaks marked α′ and α″ by him. But, contrary to his conclusion, when we compare the wave-lengths of points on the *M*-emission bands with the wave-lengths of the *M*-absorption edges which we have determined[1], we arrive at the definite result that for both copper and zinc the peaks marked α′ are part of the main emission band, only the α″ peaks being satellites. Also it would, in the present case, be difficult to understand how the Auger mechanism could account for more than one satellite. A wave-length error, either in the *L*-absorption or the *L*-emission band of copper, seems the most likely explanation of the discrepancy.

If the α′ peaks are to be included in the main bands, the shapes of the *L*- (or *M*-) emission bands, free from satellites, can be fairly accurately gauged from Farineau's Fig. 1, except in the case of zinc. Two points of interest stand out. (1) The curves show the shifting of the main peak (certainly due to 3*d*-electrons, which form a shell, incomplete for cobalt and nickel but complete for copper and zinc) towards the low energy end of the band as we pass from nickel to zinc. It is true that the resolving power of the method is not very good, being limited by the Auger broadening of the excited state. The unsharpness of the high-energy edge of the main bands gives a measure of this broadening. (2) The total breadths of the bands obviously represent the energy-spread of the conduction (4*s*) electrons. For copper, it may be taken as 8½ volts, including the α′ peak, but correcting for the unsharpness of the edge. It is found that this is only a little greater than the breadth of 7 volts calculated, assuming one conduction electron per atom, on the elementary Sommerfeld theory (this correspondence is fairly general[2].)

Now nickel and copper have the same crystal structure and almost the same lattice constant. So, from the present point of view, they differ only in the number *N* of conduction electrons per atom. Since the band-width is proportional to $N^{2/3}$, the energy-spread (6 volts) for the nickel band allows us to determine *N* for nickel as 0·59. This agrees excellently with the value postulated to explain the magnetic properties[3].

H. W. B. SKINNER.
J. E. JOHNSTON.

H. H. Wills Physical Laboratory,
University, Bristol.
Aug. 18.

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[1] Skinner and Johnston, *Proc. Roy. Soc.*, A, **16**, 420 (1937).

[2] See O'Bryan and Skinner, *Phys. Rev.*, **45**, 370 (1934).

[3] See Mott and Jones, "The Theory of the Properties of Metals and Alloys", chap. vi.

Points from Foregoing Letters

AN account of the Kyoto University expedition to Peru to observe the total solar eclipse of June 8, 1937, is given by Prof. Issei Yamamoto, who states that excellent photographs showing the structure of the inner corona were obtained by means of a ten-metre camera.

A graph showing that the resistance of zinc-blende, after excitation by blue light and 'quenching' by heat or infra-red light, decreases linearly with time is submitted by Dr. A. L. Reimann. The author infers that the electrons experience increasing difficulty in finding 'positive holes' to combine with as quenching proceeds. The linear rate of decay of the phosphorescence of zinc-blende, the author states, also agrees with this view. An outline of a mechanism of conduction is sketched, which seems necessarily to follow from the decay data, together with the results of early work on other photo-conductivity phenomena by Gudden and Pohl.

Drs. F. G. Mann and A. F. Wells show that aliphatic trialkyl phosphines and arsines unite with cuprous and argentous iodides to give fourfold molecules, $[R_3\text{P(As)}\rightarrow\text{CuI}]_4$ and $[R_3\text{P(As)}\rightarrow\text{AgI}]_4$, the structure of which has been determined in detail. Aurous halides give, however, the simple compounds of type $[R_3\text{P(As)}\rightarrow\text{Au}X]$, the phosphine members of which can be distilled without decomposition.

Prof. K. C. Bailey states that a gas flame 5–6 inches high can be extinguished by a jet of coal gas from a cylinder, without the jet being ignited. He infers that coal gas from a cylinder, bursting during a fire, may extinguish the fire locally, and thus make an opportunity of mingling with the air, and forming an explosive mixture, possibly with disastrous results.

Further work by Prof. A. E. Braunstein and M. G. Kritzmann on the transference of an amino group and two hydrogens from glutamic to pyruvic acid (with the formation of alanine and ketoglutaric acid), shows that the reaction is a reversible one. The enzyme responsible for the process occurs in various organs (muscle, brain, liver, etc.). The exchange of amino group and hydrogen atoms takes place between other similar molecular couples, provided either the amino- or the ketoacid has two carboxylic groups.

Prof. F. A. Paneth brings evidence to prove that the number of stones, of one gram weight and heavier, in the Pultusk meteorite shower was of the order of 100,000. He also discusses the correct spelling of "Widmanstätten figures" (etching-patterns on iron meteorites).

It has been found that prolactin, a hormone stimulating milk production, will cause growth of the crop glands of the pigeon. Drs. S. J. Folley and P. White now find that if the pigeons are previously given injections of one of the female sex hormones, œstradiol monobenzoate, a marked inhibition of the crop gland response to prolactin is observed.

Prof. J. H. Orton states that the spatfall of the cockle is observed in localities where slack and eddy waters occur, that is, where tidal streams meet or where banks shelter a stretch of ground from prevailing winds. As many as 100,000 young cockles per square metre may occur in the centre of such areas.

The consumption of oxygen in sea water (that is, the amount of oxygen disappearing after ten days from samples of sea water obtained from various depths and kept under controlled laboratory conditions) has been determined by H. R. Seiwell. It appears that conditions in the sea, other than temperature, restrict the rate of oxygen consumption as found in the laboratory, since some of the results obtained, *particularly for the deeper levels*, are much too high as compared with previous estimates.

Prof. George K. K. Link reports that *Rhizobium phaseoli*, the bacterial incitant of nodulation of bean roots, produces the heteroauxone β-indolacetic acid when grown in pure culture in tryptophane-containing broths. He finds also that nodule extracts contain β-indolacetic acid, which may account for nodule production and for the beneficial effects of green manuring with nodule-bearing plants, and of humus soils, manures and mycorrhizal fungi.

Research Items

Canoes of Oceania

DR. A. C. HADDON and MR. JAMES HORNELL have made a detailed study of the canoes of Oceania, of which the first volume by Mr. James Hornell, dealing with the canoes of Polynesia, Fiji and Micronesia (Bernice P. Bishop Museum, Honolulu, *Special Publications* 27) is based in part on personal investigations in certain of the islands in 1924–25, in part on an exhaustive and critical examination of references in early travel literature with its illustrations, as well as of the models which are preserved in museums. References in early literature are usually inadequate, while the illustrations and the models are often inaccurate. Problems of distribution and dispersal will be considered by Dr. Haddon in a third volume. From the present collection of facts certain general conclusions as to population movements in Polynesia emerge. Two classes of vessel have to be taken into account, the outrigger and the double canoe. In outrigger canoes, in addition to rig and form of hull, the number of outrigger booms and the method of attachment to the float must be considered; in the double canoe the form and relative proportion of the hulls. The fundamental canoe types are reducible to three: (1) Proto-Polynesian, in which the hull has pointed ends, inclined upwards, but little emphasized, is strengthened by inserted ribs, and the canoe is rigged with a primitive sprit-sail; (2) Melanesoid-Polynesian, with head low and stern curved up high, profusely ornamented with carving, the sail a primitive sprit-sail, triangular or subtriangular; (3) Tangaroan, plank-built hull with ribs tied to ridges, the planks sewn together through holes, rigged with a primitive lateen sail. This third type was probably introduced by an Indonesian people who worshipped Tangaroa. From the evidence of the canoes it may be argued that the Proto-Polynesians reached Polynesia direct from Indonesia by way of Micronesia; and not after coasting along the shores of the Melanesian Islands as is held in the generally accepted view.

Fishes of Paraguay

A REMARKABLE similarity exists between the fish fauna of the La Plata and that of the Amazon basin, and two explanations have been offered: that the two faunas represent the same initial stock, which by migration over the marshy uplands between the Tapajos and the Paraguay or across the low divide between the latter and the Guaporé peopled the two river basins; or that the two faunas illustrate the parallel evolution of two distinct stocks. A contribution to a solution of the problem is made by Prof. Nathan E. Pearson, who has listed the fishes of the Paraguayan basins, and considers that it is unnecessary to assume parallel evolution to explain their Amazonian resemblances (*Pub. Calif. Acad. Sci.*, **23**, 99; 1937). Migration is a sufficient explanation. The fishes entered South America some time during the Tertiary Period and crossed the low Amazon valley and a highland divide to enter Paraguay. The Rio Guaporé and other tributaries of the Amazon seem to have afforded the migratory paths. At the present time, the possibility of such migration has been cut off, since the fall in the volume of the streams flowing from the highlands of Matto has given rise to an effective barrier, but the nature of the fishes on the two slopes of that barrier indicate that it is of recent origin.

Life-History of *Apophallus venustus*

FOLLOWING a previous account of its morphology and taxonomy, T. W. M. Cameron has published an account of the life-history and bionomics of the trematode, *Apophallus venustus* (*Canadian J. Res.*, **15**, No. 2; 1937). This trematode is endemic in the Lower Ottawa Valley, and has been found in cats, dogs and racoons. It has also been found in the great blue heron, though not in several other species of fish-eating birds examined. The first host is an operculate snail, and the only species discovered naturally infected was *Goniobasis livescens*, in which the percentage of infection may reach 31·6. The metacercaria stage lives in the second host, a fish, and eleven out of twelve species of freshwater fish when eaten by cats under controlled conditions were found to be capable of carrying infection. The metacercariæ are present in the subcutaneous tissue or the muscles. The adult in the cat lives principally in the ileum, and in the laboratory all infected cats lost their infection during the winter, so that the reservoir would appear to be the fish.

Lac in Malaya

ATTEMPTS to cultivate the lac insect (*Laccifer lacca*) outside India have been made from time to time. The most recent effort has been tried out in Malaya and an account of the experiment is given by Mr. N. C. E. Miller in Scientific Series No. 19 (1937) of the Department of Agriculture, Straits Settlements and Federated Malay States. Consignments of brood lac for the work were obtained from the Lac Research Institute, Nankum, India, in which country the insect has been propagated for several hundred years. It may be added that about 25,000 tons of shellac products are exported annually from India to all parts of the world. The consignments received in Malaya were used to inoculate rain trees (*Enterolobium saman*), *Cajanus indicus*, *Zizyphus jujuba* and plantation rubber trees. The outcome of the experiments was disappointing. It was decided that the climatic conditions in Malaya, especially the high degree of humidity, and other circumstances are wholly unsuitable. The very young insects, or swarming larvæ, showed a prominent tendency to colonize the host trees towards or on the main stems and to neglect the young growing shoots. Owing to this erratic behaviour and the rapid suberization of the branches, they failed to survive. Another contributing cause of the failure was the prevalence of a chalcid parasite of destructive propensities. These causes, and the inroads made by synthetic substitutes for resins, are stated to have led to the abandonment of any further trials.

Endosperm and Embryo in Reciprocal Cereal Crosses

In reciprocal crosses of plants with different chromosome multiples, the more successful cross is usually the one in which the high chromosome number comes from the female parent. Messrs. J. W. Boyes and W. P. Thompson (*J. Genet.*, **34**, No. 2) discuss this subject in relation to cereals, recording a series of observations on embryo and endosperm development in reciprocal hybrids between *Triticum vulgare* and *T. durum*, *T. vulgare* and *T. dicoccum*, *T. spelta* and *T. monococcum*, as well as back-crosses and crosses between wheat and rye. Chinese wheat, unlike other varieties, can be readily crossed with rye pollen. In the crosses low-chromosome female × high-chromosome male, although there is a higher rate of endosperm growth, abnormalities in the endosperm are frequent. These include nuclei of unusual sizes, abnormal structure and irregular shapes, weakly staining cytoplasm and persistent non-cellular regions. The reciprocal crosses do not show these abnormalities, except in the widest crosses. The embryo, on the contrary, is healthy in development in all except the widest crosses, and the reciprocals show very little difference. In rye (7 chromosomes) × wheat (21), fertilization rarely occurs although the pollen germinates well on the rye stigma. In the back-crosses F_1 female × *vulgare* male, the endosperm varies widely from normal to conspicuously abnormal. This is attributed to a variable amount of chromosome unbalance, which is believed to be one of the causes of the differences in the endosperm of reciprocal crosses.

Diseases of Ornamental Plants

The *Gardeners' Chronicle* of July 10 announces the appearance of two fungus diseases upon ornamental plants. Mr. D. E. Green directs attention to a downy mildew of snapdragons caused by *Peronospora Antirrhini*. The disease has been known in southern Ireland, and has now appeared in England. It checks the growth of young shoots, has a tendency to curl the leaves downwards, and often causes the plant to send out many small shoots from the base. Messrs. A. Beaumont and P. H. Gregory describe a leaf-spot disease of *Gerbera Jamesoni*, a plant which can be grown outside for market in Devon and Cornwall. The fungus *Ascochyta Geberæ* attacks the leaves, and produces brown spots with margins of purple. Pycnidia of the fungus are embedded within the tissue of the spots. The disease appeared in Italy in 1913, and has not since been described until its occurrence in Cornwall in 1936.

Protective Spray Deposits

The efficiency of protective insecticides and fungicides depends largely on the amount of spray material which remains on the foliage immediately after spraying, and the degree to which this resists the various agencies which tend to remove it. Fajans and Martin (*J. Pom. and Hort. Sci.*, **15**, 1, 1–24; 1937) denote these two properties by the terms 'initial retention' and 'tenacity' respectively. They describe laboratory experiments from which are evaluated the effects of a number of spray supplements, particularly wetting agents, on initial retention and tenacity, the supplements being added to spray materials used in the form of suspensions. In the majority of the systems examined, the initial retention of a suspension was found to be the same as that of the aqueous phase, but in some cases the latter was reduced by the presence of the solid particles. This reduction seems to be related to an effect on the wetting and spreading properties of the spray, but is not independent of the nature of the surface sprayed. The tenacity of the spray deposit is dependent upon the characters of the spray supplement, the solid particles and the surface sprayed. It is comparatively higher on surfaces wetted with difficulty and is enhanced by oils, both hydrocarbon and glyceride. Highly surface-active supplements, especially at high concentrations, reduce tenacity, whilst those like gelatine and lime casein, which yield residues insoluble in cold water, have a favourable effect. These conclusions were tested in the field by treating a crop of potatoes against blight (*Phytophthora infestans*) with cuprous oxide sprays to which ten different spray supplements were added. A high degree of correlation was obtained between the amounts of spray residue and the control of blight.

Meteorology of American Floods

The unprecedented floods on the Ohio and lower Mississippi Rivers last winter, coming so soon after the exceptional floods of March–April 1936 in the middle and north Atlantic States, have led C. F. Brooks and A. H. Tiessen to a study of the meteorology of such floods. An account of their work has appeared under the heading "The Meteorology of Great Floods in the Eastern United States" (*Geographical Rev.*, **27**, No. 2, April 1937) and has recently been reprinted as a separate paper. The flood of 1937, with its monetary loss of at least six hundred million dollars, is, according to these writers, the greatest American flood on record. They find that two meteorological features are common to all great floods such as those of 1882, 1889, 1903, 1913, 1922 and 1927, and those of the last two years, namely, "a rapid and continuing flow of moist tropical air into the country and a frequent and persistent elevation of this tropical current by a colder air mass over the same region". This arises from a persistent anticyclone over the western part of the North Atlantic and another over the central or northern interior of the United States, or a little farther to the west. The one drives tropical air northwards, the other polar air southwards, and ascent of the warm air is continuous and sometimes violent along the front between the two. The importance of the weather before the heavy rains that are the immediate cause of the flood is pointed out; a rapid run-off is favoured both by wet weather which saturates the ground and by severe frost that makes it impermeable; on the other hand, dense vegetation and a dry soil or a deep cover of snow over unfrozen ground may entirely absorb five inches or more of rainfall. The fact that great floods are confined to the winter and spring is to be attributed to the vegetation that protects the summer and autumn by hindering run-off and rapidly using ground water.

Young's Modulus Apparatus

The August issue of the *Journal of Scientific Instruments* contains a description of an interferometer apparatus for the accurate determination of Young's modulus over a wide range of temperature, devised by Mr. J. W. Cuthbertson of the University of Manchester. A bar of the material about 9 cm. × 0·6 cm. × 0·3 cm. is supported symmetrically on parallel horizontal knife edges about 4 cm. apart; the load is applied by needle points, near the ends of the bar, which support a bar to whose centre the load is applied by weights or by a lever. The rise of the centre of the test bar is transmitted by an invar wire to a tripod the other two legs of which are supported by hole and groove in a fixed plate. The tripod carries the lower plate of an interferometer the upper plate of which is fixed. The interference bands in reflected light are observed in a microscope and the number which pass a fixed line, as either load or temperature is gradually changed, is counted to get the rise of the centre of the bar. The bar and its supports are suspended in an oil bath by rods of invar bolted to horizontal iron beams which carry the interference apparatus. A few typical results are given.

Detection of Destructive Larvæ in Timber

IN the National Physical Laboratory Report for 1936 (London: H.M. Stationery Office. 2*s*. 6*d*.) Dr. R. L. Smith-Rose, the head of the radio department, describes an acoustic-electrical equipment for detecting destructive larvæ in timber. At the request of the Forest Products Research Laboratory, he explored the possibilities of applying microphone and amplifier technique to the detection of larvæ in specimens of timber. The first experiments showed that there was little likelihood of the successful application of a method of this kind to the detection of larvæ in buildings or growing timber, owing to the faintness of the sounds concerned relatively to the associated background noises. Further experiments carried out when the specimens were housed in a sound-proof container were promising. A suitable equipment was designed and constructed. The specimen of timber to be examined was placed in a sound-proof container with a suitable control specimen and a microphone was laid on each. When the specimen contained larvæ, the noises made by these could in general be readily distinguished from the more uniform background noise of the amplifier itself. In some instances different larvæ could be distinguished by the differences in the sounds they made. A description of the equipment used has been prepared for publication.

Reflection of Radio Waves in the Atmosphere

THE well-established reflection of radio waves in the upper atmosphere takes place at apparent heights of 100–200 km. and it is generally believed that the damping effect of atomic collisions on ionic motion prevents reflection from ionized layers much lower than this. R. A. Watson-Watt, A. F. Wilkins and E. G. Bowen (*Proc. Roy. Soc.*, A., **161**, 181) have now observed reflection from much lower levels. They used the pulse technique, refined so that a very short pulse was transmitted upwards and echoes of very short delay could be observed on a cathode ray tube. Continuous records and 'snap' observations were both used. The observers were able to detect a series of reflections which they interpret as arising from a few layers at height about 10 km., possessing reflection coefficients of the order 0·7 (for 50 m. waves and vertical incidence). The layers are fairly persistent in time and occur both by night and by day. The records also reveal reflections from the Appleton *D* region (50–90 km.) and from stratospheric layers at about 30 km. A feature of *D* region reflection is the occurrence of sporadic bursts of reflection lasting a few seconds. The appearance of a 30 km. reflecting layer has on several occasions been correlated with thunderstorms, and an appendix to the paper shows that the 'runaway electrons' predicted by C. T. R. Wilson should be bent round by the earth's magnetic field and might produce ionization of the type required. The occurrence of these low reflecting layers may have some practical bearing on short-wave transmission and in particular on television phenomena.

Concentration of Nitrogen Isotope

BY using the exchange reaction between ammonium sulphate and ammonia gas, H. C. Urey, M. Fox, J. R. Huffman and H. G. Thode (*J. Amer. Chem. Soc.*, **59**, 1407; 1937) have been able to concentrate the heavy isotope of nitrogen, ^{15}N, for use in biochemical and chemical investigations. A solution of ammonium sulphate was pumped into the top of a fractionating column under low pressure, ammonia was liberated from the salt at the bottom by addition of caustic soda, and the ammonia gas stripped by a packed column. This ammonia was fed back to the bottom of the column and escaped at the top. As a result of a 13-day run, nitrogen containing 2·54 per cent of ^{15}N was obtained, an increase of concentration of 6½-fold. The samples were analysed by the Bleakney mass spectrometer, giving an accuracy of 0·02 per cent ^{15}N.

Structure of Water

THE open tridymite-like structure of ice as regards the distribution of the oxygen atoms appears to have been definitely established by Barnes, and Pauling's explanation of the discrepancy between the entropies of ice calculated by Nernst's theorem and statistical methods indicates that the hydrogens are unequally spaced between the oxygens. Present theory, as developed by Bernal and Fowler and modified by Katzoff and others, considers liquid water at ordinary temperatures as having essentially a broken-down ice structure, permitting closer packing with a considerable amount of co-ordination persisting through hydrogen bonds. This co-ordination decreases with rising temperature or addition of electrolytes. According to Pauling, two of the four hydrogens which surround a four-co-ordinated oxygen atom tetrahedrally are bonded to it in much the same manner as in an isolated water molecule, while the other two hydrogens are at a greater distance (1·77 A. instead of 0·99 A.) from the oxygen and essentially bonded to other oxygen atoms. The oxygen nucleus in ice has four oxygens tetrahedrally bonded at 2·76 A., with a proton along each O—O axis. An examination of the Raman spectra of ice at 0°, of water over a wide range of temperatures, and of deuterium oxide, has been made by P. C. Cross, J. Burnham and P. A. Leighton (*J. Amer. Chem. Soc.*, **59**, 1134; 1937). The results are interpreted on the basis of a model consisting of O—H oscillators perturbed by various types of co-ordination. A semi-empirical treatment indicates that in ice at 0°, the four-co-ordinated structure predominates, but appreciable amounts of three- and two-co-ordinated molecules are present. Water is rather more than two-co-ordinated at 25°–90°, and is slightly less co-ordinated than deuterium oxide, two-co-ordinated structures predominating in both liquids. Little significance is attached to the existence of definite polymolecular structures such as $(H_2O)_2$, $(H_2O)_3$, frequently postulated as existing in liquid water.

Egyptian University Scientific Expedition to South-West Arabia

By Dr. S. A. Huzayyin

BETWEEN April and October 1936 the Egyptian University of Cairo sent out a scientific expedition to Yaman and Hadhramaut. It consisted of four members, and was intended to carry out researches in the fields of geology, physiography, archæology, anthropology and entomology. The expedition covered a distance of some 2,500 kilometres and was able to carry out intensive researches at various localities both on the High Plateau of Yaman and in the interior of Hadhramaut. The material brought back has not been studied in detail as yet; but a preliminary note can be given here.

GEOLOGY

One of the expedition's main aims was to work out certain problems connected with the geological history of the southern borders of the Red Sea. We worked at a number of points along the lines of rifting both south and west of the Yaman Plateau, where the old crystalline rocks (schists and granites) of the base were exposed under later (secondary and tertiary) sediments and lavas. The successive horizons of the tertiary traps of the High Plateau were carefully examined and specimens collected. In north-east Yaman we worked chiefly on Jurassic limestones and Nubian sandstones, and a large collection of fossils was made from the successive zones of the former. The interior of Hadhramaut was found to have a relatively simple structure and to consist mostly of Eocene limestones on earlier unfossiliferous sandstones. We hope that new evidence from the lower part of the Eocene may throw useful light on the date of the trap volcanic series of tertiaries in south-west Arabia.

PHYSIOGRAPHY

Pleistocene geology proved to be quite interesting. We worked chiefly on the middle parts of the valleys, which were relatively independent of changes in base (sea) level. Two physiographic cycles were established, the first being by far the more pronounced. Valleys with sloping sides were first cut and then filled with coarse gravels which now rise (usually in two or more terraces) to some 30 m. above the beds of the streams. During this stage there was a good deal of lateral wash and erosion in the middle parts of the valleys, and this erosion was probably responsible for the sloping sides of the V-shaped valleys. The gravels were examined at a large number of exposures, but unfortunately they produced only one or two specimens of pre-Chellean appearance.

The second physiographic cycle was associated first with the cutting of new steep-sided valleys *emboitées* in the older gravels, and then with the filling in of these new valleys with soft sediments of silt. Deposition was much more regular and there was very little lateral wash in the middle parts of the new valley-beds. The discharge during the depositional phase of the second cycle was much less than that during the depositional phase of the first cycle, as only soft silt could be carried to the middle courses of the streams. The two cycles were separated by a phase which was marked by extensive volcanic activity, especially in north-east Yaman, where the lava spreads always cover the old gravels and underlie the silts. The second cycle was followed by erosion, during which new torrential beds were cut into the silts (sometimes producing a series of erosional terraces). There has also been a still more recent (historical) outburst of volcanic activity (on a much more limited scale), the accompanying features of which are still noticeable in hot springs, etc.

We were able to associate the two physiographic cycles (or at least their depositional phases) with pluvial episodes. During Quaternary times this corner of Arabia seems to have had two major Pluvials separated by an Interpluvial. It was not possible to work out the stages of the first Pluvial, which was a prolonged one, and which must have had more than one sub-maximum (as shown by terraces); but there is presumptive evidence from one or two places that the second Pluvial may have had two sub-maxima separated by an Intrapluvial. In recent times there was a new wet phase (shown by archæological and other evidence), which we believe to have continued well into the Christian era (perhaps to the fifth century A.D.).

ARCHÆOLOGY

The south-west plateau of Arabia proved to be singularly poor in prehistoric remains. Perhaps the great height (mainly above 1,500 m.) and the unfavourable climatic conditions during pluvial episodes contributed to this. It is to be recalled that very few remains have thus far been found at the high altitudes (above 6,000 ft.) of the opposite coasts of East Africa. We have carefully examined gravel exposures and have carried out experimental excavations at no fewer than fifteen caves and rock shelters in Yaman and Hadhramaut, but the results were largely negative. Surface specimens were looked for all along the route, but they were found only in very limited numbers and in particularly favourable localities; they belong typologically to Lower and Middle Palæolithic and rarely to the Upper Palæolithic. Whatever may have been the reasons, the scarcity of even surface finds shows that even if remains of prehistoric man may some day be forthcoming from this region, they will never be comparable in quantity with those from the African side. This reflects rather unfavourably on recent views put forward with regard to East Africa as a centre of cultural diffusion in Lower Palæolithic times.

Remains relating to the early historic phase of the area were, on the other hand, particularly abundant. Work and excavations at a number of places in Yaman and Hadhramaut have yielded fairly illuminating results. New light is thrown on relations between south-west Arabia on one hand and the Hellenistic East and Græco-Roman Egypt on the other, during the early centuries of the Christian era.

More than a hundred new Sabaitic inscriptions were copied and photographed. At three sites in the Aden and Hadhramaut protectorate, particularly the ruins of Reiboun (near Mash-had) there is, on the other hand, contacts with East Africa. Here we found an industry of obsidian (with some flint) in definite association with pottery and with Sabaito-Himyaritic inscriptions, all found in shallow kitchen midden-like remains and amongst ruins of ancient buildings and habitations. Some of the characters were actually inscribed on the pottery both before and after baking. The obsidian industry includes practically all the types and sub-types of the so-called final Palæolithic and Neolithic cultures of East Africa—Wilton, Elmenteitan and Gumban. There are small nuclei, simple and retouched blades, truncated and notched ones, small backed knives, trapezoidal forms (in abundance), true lunates (less abundant), chisel-ended tools or *pièces écaillées* ('sinew-frayers' of Dr. L. S. B. Leakey), borers, medium-size and small burins (but not the micro-burin proper) and scrapers of various descriptions (nucleiform, round, at end of blade, etc.). Yet there can be no doubt about the Sabaito-Himyarite date of this industry in south-west Arabia (the few centuries centring round the beginning of the Christian era).

Apart from inscriptions (on stone and on pottery) there are metal elements and beads of dating value. The pottery here is much more developed and varied than in East Africa, but this is to be expected in a country with more progressive civilization. One cannot argue from the evidence we have for the separation of the obsidian industry from the rest of the datable remains which must all have belonged at least to one and the same culture phase[*]. If this be so, the dates assigned by Dr. Leakey and others to the so-called final Palæolithic and Neolithic industries of East Africa will have to be revised. It would be unreasonable to argue for a 'survival' into historic times of an obsidian and flint technique in south-west Arabia after it had been introduced from the African side at a final Palæolithic date. It would be rather in this latter region (East Africa), which produced no such highly progressive civilizations as we know from south-west Arabia, that we should expect such 'persistence'. Perhaps many of the Microlithic elements of industries in East Africa may ultimately prove to be of comparatively recent historic date (Christian era).

We have also discovered, at a number of rock shelters in the Middle Wadi Hadhramaut, rock drawings (both animals and men) of both naturalistic and schematic styles. The former were associated with Himyaritic inscriptions (mostly names and cartouches), while the latter were of much more recent appearance. At the base of some of the rock shelters we found a flake and blade industry of flint which we have reason to associate with the first series of drawings.

ANTHROPOLOGY

Anthropometrical measurements were made of 1,350 male individuals, of whom 800 were studied in Yaman and 550 in Hadhramaut. More than 400 individuals were photographed full face and profile. The individuals are representative of the great majority of the tribes inhabiting the area, and useful light may be expected to be shed both on local distribution of anthropological features and types and on similarities and connexions with neighbouring areas in Asia and Africa. Already interesting links are being worked out with Iran and the west Deccan. Local differences have also been worked out within both Yaman and Hadhramaut. The population of the northern part of the Yaman plateau is essentially mesocephalic, though it also shows certain features due to mixture. South Yaman, on the other hand, has broader heads. There is also a number of Jewish colonies in Yaman from whom representative groups were measured. In Hadhramaut we have a markedly brachycephalic type (very dominant, especially in the interior) and a mesocephalic one (especially on the coast). The broad heads of Hadhramaut show interesting anthropometrical features, and the roundness of their heads is primarily due to shortness (flattening of the back) rather than to width. Armenoid affinities among the broad heads of south Arabia are already known from previous observation and measurements (Bertram Thomas, etc.). The High Plateau of Yaman is practically free from prognathism, which becomes more and more marked as we go eastwards into Hadhramaut. We have reason to believe that this feature was not the result of crossing with Negroids from Africa, but represents an element brought from farther East. Special attention, however, has been paid to cases and areas of metisation between Negroid and Arab types, especially in coastal regions. Some peoples of the coastal plains of west Yaman have been shown to have marked affinities with the Negroids of Africa, who, however, do not seem to have affected the High Plateau to any appreciable extent. Certain parts of the Hadhramaut coast are equally mixed, and even in the interior there are colonies of imported elements (for example, Negro soldier-slaves, Indo-Chinese and Chinese elements as slaves and wives brought back by enterprising merchants of Hadhramaut, etc.).

ENTOMOLOGY

Between five and six thousand specimens have been collected, and a large number of these were actually set in the field. They represent fauna from all the altitudes we have passed through (from sea-level to 3,500 m.). The identification of our specimens will inevitably be a long process, but it is hoped that fresh light may be thrown on the question of migration between adjacent parts of Africa and Asia in these regions. One of the chief topics we worked upon was the question of locust breeding-grounds and migrations, and already some useful results have been achieved in this direction.

In addition to these topics, members of the expedition carried out side-line investigations, such as the taking of a meteorological record during the journey (with as few breaks as possible), the collection of plants and small animals in localities which have not been visited before and of fishes and aquatic fauna from all streams and springs along the way, as well as the recording of observations on the general geography and ethnography of the lands and peoples in the areas visited.

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[*] Should there be any chance of such a separation, however, the only possibility would be that at a posterior date poorer tribes took shelter among the Sabaito-Himyaritic ruins and left their obsidian industry thoroughly mixed with earlier remains. In that case the lithic industry would be still more recent than the Sabaean phase. There can be no possibility of the Sabaito-Himyarites having chosen for sites of their cities places where earlier obsidian and flint-using tribes left their kitchen midden and rubbish heaps.

The Location of Industry

THE attention which is now being given to the location of industry was reflected not only in Prof. P. Sargant Florence's presidential address to Section F (Economic Science and Statistics) of the British Association on September 3, but also in the discussion by the same Section on September 2 of problems of labour transference. Mr. H. C. Emmerson, assistant secretary to the Ministry of Labour, who opened the discussion in place of Mr. Humbert Wolfe, described the work which the Ministry of Labour has been carrying out since 1928 to assist the unemployed. Men and women from the depressed areas are given the first opportunity of vacancies in other areas and are assisted if necessary by free travel, special allowances and a lodging allowance. In 1936, no fewer than 20,000 men and 8,000 women were placed through the exchanges. A juvenile employment scheme was started in 1928, and Mr. Emmerson also described a household removal scheme by which a man is assisted to take his family to the place of his new employment, and a family removal scheme which sends members of one family to work in one place. 10,000 removals have taken place under the two schemes.

The Ministry of Labour's present policy is largely directed to the movement of workers to specific vacancies, and this was severely criticized by Mr. S. R. Dennison, of the University of Manchester, who argued that in spite of the success achieved the basic policy is sometimes wrong. Employers expect a higher standard of work from men supplied by the exchanges than from those recruited directly. Mr. Dennison believes that transference should be accelerated not during boom years but when there is a slump, and urged that the Ministry should be filling 90 per cent of the vacancies instead of the present 25 per cent. In Lancashire, the existence of a family income is a strong deterrent, and Mr. Dennison also considers that with the present policy a depressed area is left heavily weighted with unemployed in the lower and higher age groups, and in consequence with more dependants, a falling income and increased depression. In that direction complete evacuation is the only logical policy.

The social consequences of industrial transference were discussed in a paper by Mr. A. D. K. Owen. For communities from which transference has taken place on an appreciable scale, the most obvious consequence is either a diminution in population growth or an actual fall in population. Up to the present, the high rate of natural increase (due to relatively low death-rate and high birth-rate) in the areas from which most transference has taken place has compensated to some extent for the loss of population by migration. More important, however, are the modifications in the age-structure of the population resulting from migration. Industrial transferees are mostly young people; there has in consequence been a marked ageing of the population in the depressed areas, and this tendency will increase in the next few years. Moreover, as the transference is voluntary, it acts as a selective process which tends to lower the average quality of the population left behind. With some important exceptions, it is the more active and adventurous elements in the community which tend to migrate. The immediate effect of transference is to reduce unemployment in the depressed areas from which it takes place, but the ultimate effect may well be different, especially if skilled or potentially skilled workers are transferred. Denudation of skilled workers or of the most promising young workers may actually increase unemployment by impeding the development of new industries and in time depressing existing industries still further. The development of new industries in the depressed areas has already involved the return of some skilled transferees.

Where transference has resulted in an appreciable fall in population, it has considerably eased the problem of overcrowding as well as reduced the pressure on local social services, but there are losses in institutional life as well as in rate income. For communities to which transference has taken place there is a valuable gain in population, which provides a basis for industrial expansion but also raises many difficult problems for local government authorities in the expanding areas. Overcrowding is very serious, as well as transport problems and the provision of a sufficient number of new schools. In spite of difficulties of assimilation and social friction, the introduction of large numbers of new workers and their families into fresh areas is socially invigorating, and the redistribution of the labour supply in relation to economic opportunities represents a considerable economic gain. On the other hand, there is some reason to believe that subsidized transference is artificially distorting the industrial structure of the country. For the community as a whole the greatest gain from industrial transference has been the salvaging of young workers from the deteriorating effect of long-continued unemployment, and this must be set against the waste of social capital in the areas from which transference takes place and the devitalization of provincial or even national culture. Mr. Owen considered industrial transference should continue along different lines related to a broad plan of national development which takes account of both economic and social factors.

Dr. O. A. Oesser, in a paper on psychological and sociological aspects of labour transference, first reviewed the problems involved in relation to the condition of the material available for transfer. Highly skilled workers are more easily transferred, provided jobs are available for which their training is adequate, not only because transfer from a more skilled to a less skilled job is easier than the reverse, but also because of their frequent tradition of emigration and their higher intelligence level, wider knowledge, training and flexibility. The type of educational system may also be a factor. The social and economic conditions of the areas between which transfer is to be made must next be considered. People can be moved from areas of lower to areas of higher standards of living, but local patriotism and reluctance to move may be obstacles, as well as traditions and a subjective social status of occupation. Finally, Dr. Oesser suggested that the condition and state of industries in the area must be considered in relation to those of Great Britain as a whole, and he used the jute industry as an example to illustrate the growth of new social patterns among the unemployed and the mobility of labour between occupations.

International Society of Leather Trades' Chemists

CONFERENCE AT COPENHAGEN

THE biennial conference of the International Society of Leather Trades' Chemists took place at Copenhagen on August 29–September 2, the meetings being held in the Technological Institute there. The president for the years 1938–39 is Mr. W. R. Atkin (England). It was announced that the Procter Memorial Research Fellowship Fund had reached a total of £3,400, and it was hoped to appoint the first research scholar in October 1938. It was also decided to institute a Procter Memorial Lecture to be delivered at all future conferences, and the first will be delivered in London in 1939. Dr. E. Schell (France) was made an honorary member of the Society.

Several combined sessions were held with the German Internationalen Vereins der Leder Industrie Chemiker, before which many interesting communications were made.

Dr. K. Linderström-Lang gave the opening lecture on the constitution of proteins as elucidated by enzyme studies. Dr. Dorothy Jordan Lloyd followed with a paper on the swelling of structured proteins with special reference to the influence of the reticular tissue on the swelling of collagen in alkaline solutions.

Mr. W. R. Atkin discussed the titration curves of gelatin and collagen, pointing out that, by the application of the Procter-Wilson theory to the titration curve of gelatin, it was possible to construct a replica of the swelling curve of gelatin in hydrochloric acid. It was also demonstrated that the second isoelectric point of gelatin postulated by Wilson could not exist. Dr. F. Schneider gave a paper on the hide proteins, emphasizing that various hide proteins could be distinguished by determining their sugar and amino-acid contents. Dr. F. Stather dealt with the technical problems of fat-liquoring and stuffing of leathers, while several aspects of the chemical testing of vegetable tanned leather were dealt with by Dr. V. Kubelka.

Mr. G. Parsy discussed the *p*H values of sulphonated oils, and a new electrode for *p*H determinations was demonstrated by J. Haugaard. Dr. D. Burton described a method for determining the amount of neutralizing agent required by a chrome leather, and Dr. K. H. Gustavson discussed the concept of the chrome-collagen compound as an internal complex salt. The tanning effect of polytungstic acid was described by Dr. C. Riess, and Dr. E. Elöd pointed out in his paper the use of polyvinyl alcohol as a substitute for proteins in tanning research experiments. Dr. G. Otto compared the titration curves of synthetic tannins with those of natural tannins, and Dr. W. Grassmann described a nephelometric micro-method for the identification and estimation of tannins.

Mr. A. Dohogne discussed the relative water permeabilities of sole leathers tanned by slow and rapid methods, and Dr. A. Miekerley described some work on the combination of lignin sulphonic acids with hide substance. The fractional extraction of pine bark was the subject of a paper by Dr. Vl. Nemec, while Dr. L. Pollak explained methods for the chemical control of hide soak liquors.

During the official banquet which followed the conference, Dr. E. Stiasny was presented with the first copy of a special "Festschrift" volume published to commemorate his sixty-fifth birthday, to which contributions have been made by well-known leather chemists throughout the world.

Metallurgy and the Aero Engine

THE sixteenth Autumn Lecture of the Institute of Metals was delivered by Dr. D. R. Pye, director of scientific research to the Air Ministry, on "Metallurgy and the Aero Engine", at the Sheffield meeting on September 6.

During recent years, there has been a remarkable increase in the power output from aero engines. A comparison of two engines of the same general type and cylinder capacity shows an increase in the last seven years of more than a hundred per cent. This increase has been achieved by improvements in the quality of the fuel, which allows the combustible mixture to be supplied by a supercharger at a higher pressure and temperature. A parallel improvement in the materials of construction to meet the severe conditions of temperature and mechanical loading has taken place, and there is scarcely one major component of the two engines of which either the material or its treatment has not been modified. The problems so far as they concern the metallurgist are both thermal and mechanical. It is fundamentally impossible greatly to increase the proportion of the heat generated which is turned into mechanical work. The marked increase of power has, therefore, involved a corresponding increase in the waste heat which is to be removed. The piston, which must be receiving about forty per cent more heat, is a critical factor and the temperature attained on the piston is, from examination of the recrystallization of aluminium alloy pistons after use, of the order of 450° C.

The discovery of a new material of about the same specific gravity and thermal conductivity, but better able to maintain its strength at temperatures of 300° C. and above, would be one of major importance.

The increase of waste heat, combined with the chemical problems introduced by the use of lead tetra-ethyl in the fuel, has profoundly affected the metallurgy of the exhaust valve. In spite of great improvements in the steel, it is now necessary not only to transfer heat away from the valve head by means of hollow valves containing liquid, but also to coat the valve with special alloys to resist oxidation at the high temperatures involved. Improvements of sparking plugs involve interesting problems in which the engineer needs the help of the physicist.

On the mechanical side, the chief metallurgical problem of the aero engine is that of maintaining two surfaces rubbing together at high temperatures without seizure. This is essentially a problem of lubrication, but as the temperatures of the working surfaces increase, the viscosity of the oil gives less and less protection, and the nature of the metal surfaces themselves will play a more important part.

Working surfaces are never flat when considered in terms of molecular dimensions, and it becomes, therefore, of great importance to examine the possibility of the treatment of the surfaces in such a way as to render them less liable to seizure. The line taken by the engineer at present is to use one of the recognized methods of producing a hardened surface, but much further knowledge in this direction is still required. Beilby showed thirty-five years ago that during the polishing process the normal structure of metal is destroyed and the surface becomes amorphous. This conclusion has been confirmed by the recent work of Finch and Bowden. It has been shown that during the 'running-in' process a very thick Beilby layer of amorphous material is produced on the surface of a steel cylinder. Apart from the fact that observations have shown that a metal in the amorphous condition is harder and tougher than the crystalline variety, it is, in Dr. Pye's opinion, reasonable to suppose that an amorphous surface could be more easily protected from seizure by a thin oil film than could one of a crystalline character.

Such problems can only be successfully surmounted by the engineer with the advice of the physicist, and they are bound to assume a steadily greater importance where rubbing surfaces have to survive without seizure under high temperature conditions.

Science News a Century Ago

Faraday and Schönbein

On September 21, 1837, Faraday wrote to Schönbein, from the Royal Institution, "Your very pleasant and acceptable letter of the 9th of July with the accompanying books I received only last week, while at Liverpool, at the very meeting you refer to and I heartily wish that you had been there yourself. It is now five years since I have been able to attend any of these meetings but I was very pleased with the one to which I now refer. . . . As the Association forms no collection of books or apparatus I gave the said copy of your work to Professor Henry of Philadelphia in the United States with a view of extending what you have done as far and as fast as possible and wherever the English language is found. He was exceedingly obliged to me for it and I only wish that you and he had met at Liverpool. . . .

"With regard to Mr. Crosse's insects, etc., I do not think anybody believes in them here except perhaps himself and the mass of wonder-lovers.—I was said in the English papers to have proved the truth of his statement, but I immediately contradicted the matter publicly. . . . It is but just of me to say that in conversation with Mr. Crosse I was very much pleased with him and with the readiness with which he received my critical remarks. As regards the cristallization supposed as real, he was lugged into view and must not be charged with having pressed himself forward. He is in fact a very modest man but has been dragged into an unkind situation. . . ."

David Uwins (1780–1837)

DR. DAVID UWINS, one of the first English converts to homœopathy, was born in London in 1780, the son of Thomas Uwins, a clerk in the Bank of England and brother of Thomas Uwins, the artist. He received his medical training in London and then went to Edinburgh, where he graduated M.D. in 1803. He then returned to London, where he was made L.R.C.P. in 1807. In 1815 he was appointed physician to the City Dispensary and afterwards to the Finsbury and Central Dispensary. In 1828 he became physician to the lunatic asylum at Peckham, and as the result of his experience in that institution published in 1833 "A Treatise on those Disorders of the Brain and Nervous System called Mental". In later life, owing to the influence of his friend Frederick Hervey Quin, he took up homœopathy, and in 1836 announced his conversion to that doctrine in a pamphlet entitled "Homœopathy and Allopathy, or Large, Small and Atomic Doses". As the result of this step he quarrelled with his former friends and his health broke down owing to the stress of controversy. He died in London on September 22, 1837, and was buried in Kensal Green Cemetery.

Uwins was a prolific writer. In addition to the works already mentioned his chief publications were "Modern Medicine, containing a Brief Exposition of the Principal Discoveries and Doctrines" (1808), "A Compendium of Theoretical and Practical Medicine" (1825) and "A Treatise on those Diseases which are either directly or indirectly connected with Indigestion, and on the Principal Ailments of Children" (1827). He also contributed medical articles to Gregory's "Encyclopædia" and the *Quarterly Review*, and was for some time editor of the *Medical Repository*.

Lyell to Leonard Horner

LYELL had spent the months June to September 1837 on the Continent and thus had not been able to attend the British Association meeting at Liverpool. Just before he returned home he wrote on September 23 from Paris to Leonard Horner (1785–1864), the geologist, "I am glad to receive your report of the meeting at Liverpool, and to hear the Association was so well supported. I must try to be at the next. I saw a very blundering account of my letter in the 'Athenæum'. I am anxious that when printed by the Association, it should be given as I sent it, and this principally because I have carefully avoided bringing prominently forward any collision with Von Buch, whom I like too well not to be sorry that he should fancy, as he has done before now, that I am always seeking to run against him. I only mentioned him as having been the first to announce the posteriority of the granite to the transition beds, which was a grand step at that time, and true; though perhaps he did not come at it by a strictly logical course. I knew how he drew his inferences, which were quite natural twenty-six years ago, before he had adopted the true theory of granite, but had I brought forward his errors, I should also have dwelt on his praises. Chancellor Brougham said of Serjeant Wilde, that it was rather hard to visit on the barrister the sins which he committed in the flesh as an attorney, and I should also think it hard to show up the mistakes which Von Buch the Huttonian fell into, in the youthful days of his Wernerianism."

Societies and Academies

Paris

Academy of Sciences, July 12 (*C.R.*, **205**, 97–184).

Anton E. Mayer: Groups of curves of three lines.

Mme. Christiane Pauc: Further study of a group of infinitesimal transformations.

Jacob: Determination of the jump of a function by development in a Hermitian series.

Chi-Tai Chuang: The behaviour of a holomorph function and of its derivatives in a circle.

Pierre Chevenard and Eugène Joumier: A mechanical magnifier with enlargement of more than 1,000. Application to recording the viscous deformation of metals at high temperatures.

Max Serruys: Supplements to the nuclear inflammation theory of knocking in petrol motors.

F. J. Bourrières: The auto-oscillations of real jets in identical media by autofolds.

Albert Milhoud: Concerning the inflammation of dirigible balloons. Discussion of the conditions producing an electric spark when the valve is opened to allow the hydrogen to escape.

Roger Mérigoux: The influence of a thin layer of oil on the motion of waves.

Marcel Pauthenier, Moshé Feldenkrais and Léopold Vigneron: The absolute standardization of an apparatus for the measurement of very high voltages: the electrostatic valve. The indications of the rotating voltmeter standardized up to 50 kilovolts are in agreement with the results given by the electrostatic valve method, up to about 400 kilovolts.

Thadée Peczalski: The production by electrolysis of coloured rings in the mass of a salt.

Henri Lacoste-Tayan: Cycles of recoil in magnet steels.

Serge Nikitine: The dichroism of flow in solutions of fluorescine.

Louis Cartan: The focalization of corpuscular bundles by circular deviation in a transverse magnetic field.

Maurice Cotte: The Gauss approximation for the general systems of electronic optics.

Raymond Roure, Louis Quevron and René Gense: A photo-electric comparator. The instrument reduces the measurement of a variation of length to the measurement of a variation of current. A displacement of 1 micron produces a change of 0·4 milliampere.

René Audubert: The ultra-violet emission spectrum of the slow thermal dissociation of silver nitride. The slow decomposition of silver nitride by heat is accompanied by the emission of light, corresponding to three narrow bands between 1950 A. and 2600 A.

Emile Rinck: The diagram of solidification and electrical conductivity of the rubidium-cæsium alloys. These two metals form a continuous series of solid solutions, with a minimum solidification point at 9° C. The conductivity measurements proved that no definite compound of cæsium and rubidium is formed. These results are not in agreement with the earlier work of Goria on the same subject.

Maurice Dodé: The reversible action of iodine vapour on dry potassium nitrite. The influence of the miscibility of this salt with the corresponding nitrate.

Clément Courty: The diamagnetism of solutions of iodine and the purity of the alcohol. The law of additivity of coefficients of magnetization applies to a solution of iodine in alcohol only if the latter is pure, and such measurements can be used for detecting the presence of impurities in alcohol.

André Debierne: A new mode of transformation. When hydrogen is brought into contact with purified carbon at the temperature of liquid nitrogen a large amount of heat is set free, higher than the heat of combustion of the hydrogen with oxygen. Helium shows a heat evolution of the same order of magnitude under the same conditions, but with other gases (oxygen, nitrogen, argon) the effect is small. The source of this heat energy is unknown.

Marc Tiffeneau, Paul Weill and Bianca Tchoubar: The order of addition of the hydracids to the epoxides and of the hypohalogen acids to the ethylene derivatives, methylene cyclohexane and methylcyclohexene, as well as their epoxides.

Raymond Quelet and Marcel Paty: New methods of preparation of 5-bromo-2-methoxybenzyl alcohol and of 5-bromo-2-methoxybenzaldehyde.

André Meyer and Henri Drutel: The 2,6- and 2,8-dimethyl-4-chlorquinolines. General properties. The reactions with amines.

Henry Gault and Matus Cogan: Ethylol-formylglutaconic ester.

Alexis Tchitchibabine and Charles Hoffmann: A new (2,3,6) triaminopyridine.

Louis Martineau and Charles Prévost: The catalytic dehydrogenation of a tertiary alcohol into a ketone.

Lucien Dautrebande, Edmond Dumoulin and Pierre Angenot: Study of anti-aerosol esparto pulp filters. The perforation of anti-aerosol filters by the ageing test with steam.

Pierre Legoux: The magnesian series of supracrustal rocks of the west Ivory Coast.

Julien Durand: The structure of the crystalline region of Rouergue and of Albigeois.

Pierre Bernard: The relation between the swell on the coast of Morocco and the microseismic agitation in western Europe.

Edmond Rothé and Th. Kopcewicz: The comparison of the radioactivity of Alsatian rocks by the method of (Geiger-Müller) counters.

Albert Baldit: The influence of the terrestrial relief on the vertical movements of the air at Banne-d'Ordanche (Massif of Mont-Dore). Studies of air velocities made in connexion with a school for gliding.

René Souèges: The embryogeny of the Violaceæ. The development of the embryo in *Viola tricolor*.

Lucien Leroux: The presence of allantoic acid in the leaves of *Coryllus avellana*.

Vincent, Herviaux and Coic: The measurement of the lime capacity of soils, and the liming of acid soils.

Jean Jacques Bounhiol: Premature metamorphosis by the ablation of the *corpora allata* in the young silkworm.

Jules Alquier and Mlle. Andrée Michaux: Study of the calcium-phosphorus ratio in various tissues especially in the femurs of the growing rabbit.

Jean Lavollay and Mme. Françoise Laborey: The action of ascorbic acid (vitamin C) on the pigmentation of the mycelium of *Aspergillus niger* in the presence of magnesium in excess, and on the development of this mould.

Rodolphe L. Mayer and Charles Oechslin: Antistreptococcics. Extract from a sealed letter on the activity and toxicity of certain derivatives of benzene sulphamide.

Emile Roubaud, Jacques Colas-Belcour and Georges Jean Stefanopoulo: The transmission of yellow fever by a palæarctic mosquito common in the Paris region.

Moscow

Academy of Sciences (*C.R.*, 15, No. 4, 1937).

V. S. Ignatovskij: The Laplacean transformation (7).

G. V. Pfeiffer: Possibility of joining to a complete system of non-linear equations a linear equation or a system of linear equations.

B. Lewitan: A generalization of inequalities of S. Bernstein and H. Bohr.

G. N. Neujmin: The elements of the orbit of Comet 'Neujmin II' as computed from the connexion between its appearance in 1916 and 1927.

B. J. Svešnikov: Dependence of the rate of photo-chemical reactions in solution on the concentration of reagents.

V. Sukačev and **S. Dolgaja**: Fossil remains of plants in loess and loess-like clays in connexion with the problem of origin of these deposits.

K. A. Vlasov: The theory of desilification of granitic pegmatites.

E. S. Burkser, **N. P. Kapustin** and **V. V. Kondogury**: Helium, radium and thorium in beryllium minerals of the U.S.S.R.

D. Michlin and **P. Kolesnikov**: Influence of colloids and of electrolytes on the state of equilibrium in maltose.

D. J. Vakolin: Some data on the yield of essential oil by a new variety of dragonhead (*Dracocephalum moldavica* L. var. *hexagonum* D. Vakulin) from different seed samples.

E. M. Šepeleva: Morphology of the chromosomes of some species of potato.

B. S. Moškov: Photo-periodism and a hypothesis as to flowering hormones.

M. Ch. Čajlachjan and **L. M. Yarkuvaya**: New facts in support of the hormonal theory of plain development (2).

A. R. Verner and **V. F. Altergot**: The phenomenon of mycophagy.

Sydney

Royal Society of New South Wales, July 7.

Adolph Bolliger: Red compounds formed by picric acid and creatinine in the presence of sodium hydroxide. Four compounds have been isolated. They are characterized by a varying sodium or sodium hydroxide content. Compound I, which is obtained *inter alia* by the addition of one molecule of sodium hydroxide to a mixture of one molecule of creatinine sodium hydroxide and one molecule of picric acid, consists of one molecule of creatinine, one of picric acid and two of sodium hydroxide. Compounds II, III and IV, obtained after the addition of larger amounts of sodium hydroxide, contain two and a half, three and three and a half molecules of sodium hydroxide for each molecule of creatinine picrate. Compound IV represents the maximum degree of saturation with sodium hydroxide and has been considered as the most likely cause of Jeffe's reaction.

Vienna

Academy of Sciences, June 24

E. Steinach and **H. Kun**: Conversion of the male sex hormone into a substance with the properties of the female sex hormone. Studies with young and old men. Injection of male sex hormone produces in the urine a substance with œstrogenic properties.

J. Schintlmeister: Redetermination of the range of α-particles from thorium. The variation of the ionization along the range of the α-particles from a thorium source of exceptional purity has been studied, and the extrapolated and mean ranges in air at 0° C. and 760 mm. pressure have been determined as 2·59 cm. and 2·56 cm. respectively.

R. Weiss: 4′, 4″-dihydroxy-3′, 5′, 3″, 5″-tetrabromonaphthalene-2, 3-dicarboxylic acid anhydride.

O. Redlich, **T. Kurz** and **W. Stricks**: Spectrum of scattered light of some inorganic compounds.

Bella Bauminger and **F. Lieben**: The sugar-formic acid combination in the oxygen current.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 295–349, June 15).

D. L. Fox: Carotenoids and other lipoid-soluble pigments in the sea and in deep marine mud. Material filtered from sea water, including microplankton, fæcal matter and other organic detritus, and also marine muds from 1,000 fathoms were found by chromographic analysis to contain carotenoids, assuring a supply of these compounds even to deep-sea animal organisms.

H. D. Babcock: Internuclear distance in oxygen molecules. New determination based on measurements of twelve absorption bands of atmospheric oxygen.

J. M. Beal: Bud development in *Lilium Harrisii* following treatment with indoleacetic acid. In another species, treatment with this substance in lanoline of a stem from which the terminal bud had been removed produced protuberances found to be adventitious roots; in *L. Harrisii* buds appeared in the axils of the upper two or three leaves. These buds closely resemble bulbils (vegetative reproductive organs) normally found near the base of the stem.

S. Wright: The distribution of gene frequencies in populations. A mathematical discussion.

H. Fricke and **M. Demerec**: The influence of wave-length on genetic effects of X-rays. Wave-lengths of 0·94 A. and 2·2 A. were used. *Drosophila melanogaster* males were treated individually in a chamber in which their abdomens were compressed to a thickness of about 0·15 mm. in order to reduce absorption of this soft radiation. The frequency of lethals per unit dose is found to be the same for both wave-lengths, suggesting that the genetic changes are not due to direct activations within a gene but are probably of the nature of sensitized reactions induced by neighbouring activated molecules.

M. E. Reissner: Theory of beams resting on a yielding foundation. A mathematical discussion, from which it is claimed that, provided the deflection of the surface of the foundation due to a concentrated loading is known, then the problem of buckling of a beam of infinite length, resting on a yielding foundation and on an infinity of equidistant supports, can be solved completely.

G. A. Miller: Groups having a maximum number of independent generators.

E. Kasner: Trihornometry: a new chapter of conformal geometry. A trihorn is defined as an ordered triplet of curves which pass through a common point in a common direction. Various relationships between the conformal invariants of this configuration are derived, including the analogues of the laws of sines and cosines of ordinary trigonometry.

J. v. Neumann: Continuous rings and their arithmetics.

Forthcoming Events

Institute of Sociology, September 24–26.—Conference on "Social Stratification and Class Conflict" to be held at King's College of Household and Social Science, Campden Hill Road, W.8.

Association of Special Libraries and Information Bureaux, September 24–27.—Annual Conference to be held at Gonville and Caius, Cambridge.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Laboratory Attendant in the Science Department, South-East Essex Technical College, Dagenham—Clerk to the Governors (September 25).

Lecturer in Biology in the Kingston-upon-Thames Technical College—The Principal (September 25).

Headmaster of the Bagdad Technical School—The Secretary (*I.P.R./C.A.*), Board of Education, Whitehall, S.W.1 (September 30).

Two Inspectors for the Department of Agriculture for Scotland—Secretary (Establishment Branch), Department of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh 2 (September 30).

Assistant Executive Engineer in the Public Works Department (Irrigation Branch) of the Government of the Punjab—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 1).

Assistant Lecturer in Municipal Engineering in the Manchester Municipal College of Technology—Registrar (October 4).

Chief Lecturer in Electrical Engineering in the West Ham Municipal Technical College—The Principal (October 9).

Engineer Sub-Lieutenant in the Royal Indian Navy—Secretary, Military Department, India Office, London, S.W.1, marked "Engineer Recruitment" (October 18).

Assistant Lecturer in Mathematics in the University of Manchester—Registrar.

Engineer in the Public Works Department of the Government of Sarawak—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M. 5419).

Lecturer in Physics in the University of Reading—The Registrar.

Official Publications Received

Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 57: Mechanical Properties of some White-Bearing Metals and other Tin-Base Alloys at various Temperatures. By Dr. C. E. Homer and H. Plummer. Pp. 20+4 plates. Free. Series A, No. 58: The Tensile Properties of a Series of White-Metal Bearing Alloys at Elevated Temperatures. By H. Greenwood. Pp. 9. Free. (London: International Tin Research and Development Council.) [258

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, 22nd July 1937. Pp. 29. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [268

Norman Lockyer Observatory. Director's Annual Report, April 1, 1936–March 31, 1937. Pp. 6. Council's Report and Accounts and List of Council, Staff, Members, etc., June 1937. Pp. 12. (Sidmouth: Norman Lockyer Observatory.) [268

Readers' Guide to Books on Electrical Engineering. Pp. iii+16. (London: Library Association.) [268

London Shellac Research Bureau. Technical Paper No. 11: Viscosity of Lac and Hard Lac Resin Solutions. By Dr. Lal C. Verman. Pp. 20. Technical Paper No. 12: Modification of Lac with Higher Fatty Acids and their Mixed Glycerol Esters, Part 1. By Dr. R. Bhattacharya. Pp. 16. (London: London Shellac Research Bureau.) [268

Department of Scientific and Industrial Research. Report of Test by the Director of Fuel Research on the Plant of the National Coke and Oil Company, Ltd., at Erith, Kent; Tests carried out 26th January to 9th February 1937. Pp. vi+54+2 plates. (London: H.M. Stationery Office.) 1*s*. net. [29

Proceedings of the Royal Irish Academy. Vol. 43, Section B, No. 5: Turbellaria of Ireland. By Rowland Southern. Pp. 43–72. 1*s*. Vol. 43, Section B, No. 11: River Liffey Survey—The Chironomid Fauna of the Submerged Mosses. By Carmel F. Humphries and Winifred E. Frost. Pp. 161–181. 1*s*. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [29

Sir John Cass Technical Institute. Calendar, Session 1937–1938. Pp. 141+3 plates. (London: Cass Technical Institute.) [29

The Prediction and Reduction of Occultations. (Supplement to the Nautical Almanac for 1938.) Pp. v+46. (London: H.M. Stationery Office.) 2*s*. net. [29

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 7, No. 1, March 1935. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies. Pp. xiii+371. (London: H.M. Stationery Office.) 5*s*. net. [39

Other Countries

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The Organization of Social Research

EVERY year the social services of Great Britain tend to attract increased attention and generally to demand increased expenditure of public money. This may be all to the good; but from time to time it is desirable to attempt to survey the situation and to consider whether in practice these services are being adequately directed by controlled and informed social research. In a field of this kind, where the boundaries are extremely wide and the claims in every direction are most insistent, constant and wise research is particularly necessary if undue waste is to be avoided and if merely sectional interests are to be held in reasonable control.

As things are at present, our problems of public health have been placed upon a sound foundation, mainly through the organization and activities of the Ministry of Health and later of the Medical Research Council. Research in agriculture is now being similarly promoted by the more recently established Agricultural Research Council. The National Physical Laboratory and the Department of Scientific and Industrial Research, likewise subsidized by the State, have brilliantly developed the contributions which can be made by physics and chemistry to a great variety of industrial and even social problems. The Industrial Health Research Board, with far more slender resources and with a less independent status, has made valuable contributions to some of the problems of industrial life. So far as national organization goes, that is all. Other problems—economic, educational, biological, psychological, sociological—are left to advisory or to consultative committees, which can receive 'evidence' and issue reports (but do little else), or to private enterprise and sporadic effort.

It is high time to alter this state of affairs—to establish a new scientific body, with adequate endowment from the State, which will do for human social research what the Medical Research Council does for public health, what the Agricultural Research Council is beginning to do for agriculture, and what the Department of Scientific and Industrial Research does for the applications of physics and chemistry. Such a body must be nationally constituted; for most of the problems which it would be asked to study are the immediate and practical concern of existing government departments.

Everywhere, and in all directions, the most prodigious efforts are now being made to bring differently organized social groups into peaceful and lasting co-operation. But we have much yet to learn about the nature and extent of these differences; for example, of class-differences and of class-conflicts. In industry, in education, in politics national and international, in science, and in religion, it is essential that bases of successful co-operation be found—or the world as we know it must disappear in faction, enmity and confusion.

Scientific invention and popular education have combined to bring groups widely different in language, or tradition, or custom, or aim, or all of these, into close contact; and every day potentialities of conflict threaten to become actual or even to break into sharp strife producing lasting irritation and lamentable waste. Many of the best minds are set to devise all manner of elaborate machinery for promoting and preserving friendly relations between groups. Yet if but a fraction of the intelligence that has been put to work upon this problem of machinery had been devoted to a study of those human conditions which will inevitably wreck even the most wisely devised machinery, there would have been great economy and far more to show for the effort. The methods for a controlled study of the bases of group co-operation—and of consequent government by consent—are to hand. They can be made as scientific and as definite as those of the investigation of any other human problem. They require wide application, for which centrally and nationally organized effort is necessary.

It is clear that at the present day the great mass of the work of the world can be performed efficiently with a relatively slender equipment of intelligence, and—what is probably more important still—with only a small basis of acquired knowledge. This is due to the enormous advances of physical science and especially to the modern applications of engineering. The great requirement now, so far as the working-day activity of the masses goes, is for specialized skills, not for extensive knowledge. Moreover, the time during which these specialized skills must be kept continuously in operation in order that the basic needs of civilization may be satisfied is all the while decreasing. We may even say, with an approximation to truth, that, apart from the institutions devoted to technical training, modern popular education is now designed mainly for leisure, not for work.

We know, however, extraordinarily little of how, if at all, the majority of workers in any section of a modern community utilize their education for their leisure, and even less about how and how wisely leisure occupations are chosen and how they affect social and workaday behaviour. There can be no doubt that the views, opinions and beliefs which influence public policy in many directions are stimulated and developed chiefly during periods of leisure. Consequently, the most stable community in modern social life appears likely to be the one in which leisure is ample and most ably employed; and as science still further advances its techniques, the truth of this will become even more obvious. It is not, therefore, surprising that serious attention is at length being given to stimulating the study of leisure and of its influence in human affairs; but this study needs adequate control and organization.

Bound up with the increasing importance of leisure is the fact that leisure has itself become possible largely as a result of a great speeding-up in the *tempo* of work and in the specialization of routine processes. There is a general impression that these two conditions—speeding-up and increase of routine—are exerting profound influences upon human behaviour and consequently upon social policy. They may be responsible for special occupational difficulties or disorders, the study of which overlaps the field of medical research. They may give rise to a degree of dissatisfaction which inevitably results in various forms of group conflict. They may encourage individual maladjustments to an extent which has wide repercussions upon family and social life. Whether or no they do these things, in what directions, how and when, are all matters for speculation at the present time; but they could be made matters of far more certain knowledge.

The general drift of social development for many years past seems to have been for more and more of the functions which were formerly those of small groups to become the direct practical concern of larger ones. Thus the functions of the family—so often in a vague way said to be disastrously breaking down—in regard to education, health, industrial training, and many everyday regulations of behaviour, have passed largely to some wider authority constituted within the nation group. Similarly, the functions of local religious, industrial and general administrative groups have in many instances been lost or become strictly controlled. Coincidently, human loyalties, partly by training and propaganda, partly by natural drift, seem to have been diverted from the smaller to the larger groups, or to have changed in character as regards the smaller groups. On one hand, any more forcible and competent social group must be able to perform functions on behalf of its members better than any smaller, less organized group can do; and on the other hand, every large modern society, such as the nation group, must necessarily contain and maintain in very great variety internal social differentiation. A study, therefore, by experimental and observational methods, of the place and functions of small groups in a large society, would have a close bearing upon many urgent problems of practical social control.

These are a few only of a large number of other general problems (for example, those of population and of crime) upon the solution of which the effectiveness and stability of present and future social organization depend. They are matters of daily debate and speculation; and in that stage they will remain, unless they are conceived, as they properly should be, as problems in higher human biology, to be attacked, not by dialectic alone, but by experiment when possible and by controlled observation. Methods for such an attack are already being devised and applied. But they will have little chance of success, unless they can attract the attention of, and be refined and sharpened by, the best scientifically trained minds available.

Besides these general problems, there is a mass of more specialized questions which call for immediate and organized research. Much brilliant recent physiological investigation, on 'conditioning', on habituation, on adaptation, on inhibition and on the development of co-ordinated motor activity, has its most significant application to human behaviour. The last ten years have seen the study of the operation of incentives and 'drives' placed upon a much firmer basis in so far as the behaviour of animals is concerned; but virtually nothing is known, except in a speculative sense, about their conditions and mode of operation in human society. Modern civilization depends to a considerable extent upon skills of one kind and another, yet we are only at the outset of ascertaining the principles which determine how different skills can best be acquired and maintained. In region after region, throughout the British Empire, wherever native populations are being rapidly caught up in modern Western ways of life, urgent practical difficulties concerning education, administration, and the swift transformation of manners and customs arise and cannot be postponed. As things are, the administrator is forced to do his best to meet such problems *ad hoc* and in a hurry. There are principles underlying the correct solution of them all; but these principles demand organized research for their discovery, and hitherto the State has given no systematic support for such research.

Indeed, at the present time in Great Britain, if a government department, or any outside person or body, is brought up against some research problem underlying the administration of any branch of the social services, there is little that can be done beyond referring it to the Medical Research Council or to an advisory committee. This is scarcely fair. The Medical Research Council is usually sympathetic; but many of the problems thus proferred are remote from its terms of reference, and in any event its resources are insufficient to do much more than meet its own immediate concern with public health in the specifically medical sense of the phrase. Also, though an advisory committee can inquire into whatever research may be in progress and can collect opinions, it cannot initiate original investigations on an adequate scale.

A new, centrally constituted scientific body is urgently needed, to survey the field of social research and to set on foot considered programmes of actual investigation on higher biological lines. The questions demanding study are most of them border-line problems, at the growing points of research in different departments of science, involving organized and many-sided efforts for their solution. There is no government department that could not profit vastly from such an enterprise. Ultimately the public purse would be saved from much wasteful expenditure, and the country's social services set upon a firmer foundation of well-attested knowledge.

Exploration in Iran

Archæological Reconnaissances in North-Western India and South-Eastern Irān

Carried out and recorded with the support of Harvard University and the British Museum by Sir Aurel Stein. Antiques examined and described with the assistance of Fred H. Andrews and analysed in an Appendix by R. L. Hobson. Pp. xx + 267 + 60 plates. (London: Macmillan and Co., Ltd., 1937.) 63*s*. net.

AFTER forty years of research and exploration in and around Central Asia, Sir Aurel Stein found himself constrained by the intolerable character of the conditions imposed on his activities by the Chinese Government to cease from further investigation in a field which he had regarded as the major objective of his studies. While he has every sympathy in his personal disappointment and frustration when the expedition in Inner Mongolia was abandoned, the loss to science by the diversion of his experience and knowledge to other regions is felt to be a calamity. Nevertheless, there is compensation of a kind in the fact that by an arrangement with Harvard University and the British Museum, which were his sponsors, he was able to turn to the exploration of regions of the Middle East, which were still archæologically unexplored and geographically imperfectly known.

By October 1931, Sir Aurel's arrangements for the first of his journeys in southern Iran were complete, excepting for the official permit to travel in Persia. Pending its receipt, which was delayed until the end of the year, Sir Aurel revisited the northern Punjab and the Salt Hills, where he began his career as a field archæologist in 1889. The purpose of this interlude was to round off his studies of the invasion of India by Alexander the Great by examining the scene of the last phase of that adventure at the point where the invading forces turned back, and to determine the exact spot at which the defeat of Poros on the banks of the Hydaspes (Jhēlum) took place, a problem of which, after prolonged examination of previous theory on the ground, he concludes that a final and exact solution is improbable. In the account of his present journey in the Salt Hills, he includes the first full statement to appear, after nearly fifty years, of the detailed topographical and archæological argument by which he identified the Jain temple mentioned by the early Chinese Buddhist traveller Hsüan-tsang, and the site of the ancient Simhapura.

Early in January 1932, Sir Aurel left India for Makrān; and a few days later he crossed the frontier from the British post at Suntsar, and began under escort his long journey through Persian Makrān and Baluchistan to Kermān, where the advancing season, too hot for further archæological exploration, brought his first journey to a close. Re-assembling his party after he himself had spent a brief period in England, he set out from Kermān in October 1932, his purpose being to explore the coast of the Persian Gulf in search for early historic and prehistoric sites. He travelled south to Mīnāb at the mouth of the Persian Gulf and thence proceeded along the inhospitable coast; but before his journey as planned was completed, all further exploration was forbidden by the Persian authorities owing to tribal unrest, and his second journey came to an end at Bushire.

In the two journeys of the period 1931–33, Sir Aurel had covered two thousand four hundred miles of country, almost the whole of which was, for archæological studies, virgin territory. Of this he had also made a topographical survey, except for an interruption of his observations for a time by the officious, and as it proved, unauthorized veto of the commander of his escort. The course of his journeys was determined by archæological 'points', the occurrence of burial mounds and occupation sites of prehistoric or early historic age. It is to be noted that though historic sites were found along the actual coast line, there was none here of prehistoric age, a fact of which Sir Aurel discusses the significance and suggests that it may be due to submergence.

A large number of sites, both of prehistoric and early historic age, were examined and recorded. Time was not available for an intensive study of any one site, and there are several on which the author insists upon the urgent necessity for systematic and exhaustive excavation. It was possible, however, by surface finds and trial trenches to collect and determine the sequence of a large quantity of ceramic evidence and other material—stone and bone, copper, bronze, iron and glass (beads and bangles)—in date extending from the chalcolithic age down to the close of the pre-Islamic period, several centuries after the commencement of our era. An idea of the richness of some of the sites in archæological data may be gathered from the fact that at Damba-kōh, a hillock-site in the alluvial plain of the Bāhū river, about sixteen miles only from the frontier, there were at a rough estimate seventeen hundred cairn burials, or if those scattered nearby are taken into the account, some two thousand. The practice of cairn burial shows a considerable variety in construction, but the skeletal remains are invariably those of bodies which have been exposed previously to burial. In this area, the author infers, it must have persisted for a very considerable period, extending from the close of the pre-Islamic period back to, at least, the Iron Age.

On the prehistoric or chalcolithic sites there is abundant evidence, in the painted pottery in particular, of affinity on one side with the chalcolithic civilization traced by Sir Aurel on his expeditions to Baluchistan in 1926–28, which in turn links up with the civilization of the Indus valley, and on the other, with early western Asia. Finds from the Tal-i-pīr (Haraj), for example, especially the painted pottery and the 'button-seals', are compared with those found at Persepolis, Arpachiyah and Fars. Further, the designs in monotone of the yellowish-grey ware from this site provide a link between Persepolis and the chalcolithic site at Fars and Baluchistan, where most of the designs appear, while the bands of horns found here as a form of decoration relate Baluchistan, Iran and Susa.

Sir Aurel has modestly given to this elaborately produced and detailed account of his first two journeys in Iran the title of "Reconnaissances"; and so these journeys must be regarded, as providing both a strong incentive and guidance for further and more intensive archæological investigation—this not only for its own sake, but also for the light it will throw on the relations of early civilizations in India and Mesopotamia. At the same time, the topographical and archæological record, as well as the magnificent series of plates of the pottery and other finds, ensure its permanent standing as an authoritative work of reference.

Men and Mathematicians

Men of Mathematics

By Prof. E. T. Bell. Pp. 653. (London: Victor Gollancz, Ltd., 1937.) 12*s*. 6*d*. net.

PROF. E. T. BELL has written a fascinating book. The amount of biographical details and of mathematics that he has compressed into a volume of 650 pages is extraordinary; but he is never dull; his style is lively, at times even 'snappy'; he carries the reader along; he whets the appetite. No doubt the mathematician of a certain age who remembers little more mathematics than what he learnt at school and at the university will wish that the modern theories and developments could be more fully described so that he could get a better general idea of them; and the reader who is mainly interested in the personal and human side, while reading with enjoyment the biographical details, which are not easily accessible elsewhere, will wish for more. This is as it should be; but, if the writer has set himself what is (in such a compass) a wellnigh impossible task, we are not the less grateful to him.

Prof. Bell explains that he has applied two criteria in selecting names for inclusion: first, the importance for modern mathematics of a man's work, and, secondly, the human appeal of the man's life and character. Some, as he says, qualify under both heads, for example, Pascal, Abel and Galois; others, like Gauss and Cayley, chiefly under the first, though both had interesting lives. When the two criteria clash or overlap as between several claimants for inclusion on account of a particular advance, he has given the second the precedence, as his primary interest is here in mathematicians as human beings.

In his first chapter Prof. Bell deals with the Greeks—Zeno, Eudoxus and Archimedes; then, with a bound over eighteen centuries, he passes to Descartes and Fermat, the founders of analytical geometry. This is because, throughout the book, "the emphasis is wholly on modern mathematics, that is to say, those great and simple guiding ideas of mathematical thought that are still of vital importance in living creative science and mathematics". The particular Greeks dealt with are those whose work makes, as it were, a continuous story with that of the moderns. The story properly begins with Zeno of Elea. Zeno did not indeed claim to be a mathematician, and next to nothing is known of his life; but he put forward the four famous paradoxes which have exercised the acutest minds ever since, and even now, notwithstanding the labours of Weierstrass, Dedekind and Georg Cantor, cannot be said to be disposed of finally.

Though some of the great mathematicians were born in the humbler walks of life, they are not in a majority. Monge was the son of a pedlar and knife-grinder, Fourier of a tailor, Fermat of a leather-seller; Gauss's father worked as a gardener, canal-tender and bricklayer. Laplace was the son of a peasant and became a complete snob; he examined Napoleon as a candidate for the Military School, and afterwards, in recognition, Napoleon 'pushed' him in every possible way; he was Minister of the Interior for six weeks; under Louis XVIII he sat as Marquis de Laplace in the chamber of peers. Most of the others were sons of professional men, chiefly in the law, officials, pastors, and so on. Some were miserably poor or became so; Kummer tramping back and forth every day between Sorau and Halle with his food and books in a knapsack on his back reminds us of Eudoxus trudging from the Piræus to Athens and back to hear the lectures of Plato.

Only a few of the subjects of the book seem to have been exceptionally precocious. Though the legends of Pascal's precocity are no doubt overdrawn, he discovered his famous theorem before reaching the age of sixteen years. Lagrange is said to have become professor of mathematics at the Royal Artillery School in Turin at sixteen years of age. Gauss, before he was three years old, spoke up and corrected an error which his father had made in calculating the weekly wages of some labourers; in his tenth year he produced in a few seconds the answer to an addition sum set to his class, in which a hundred numbers beginning with 81,297 and ending with 100,899 were to be added, because he instantly saw that the numbers formed an arithmetical progression with 198 as common difference. Sir William Rowan Hamilton must almost have rivalled John Stuart Mill: he was a good reader and advanced in arithmetic at three years of age; at five he read and translated Latin, Greek and Hebrew; at eight he added Italian and French and wrote an original poem in Latin hexameters. Euler ("analysis incarnate") was, like Gauss, a marvellous calculator. Two of his students summed a complicated convergent series in specific numbers and disagreed only by a unit in the fiftieth place of the result. To decide between them Euler did the whole calculation in his head; his answer was found to be correct.

Prof. Bell has strong likes and dislikes. He cannot forgive Newton for accepting, at the age of fifty-four years, the post of Warden of the Mint, nor Leibniz for spending so much of his life in the trivial service of the Brunswick family.

Citrus Diseases

Citrus Diseases and their Control:
By Prof. Howard S. Fawcett. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Second edition, completely revised, rewritten and enlarged. Pp. xv + 656. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36*s*.

A SECOND edition, after ten years, by the senior author of Fawcett and Lee's well-known book must be welcome to a great industry and to citrus pathologists. Lee, being engaged on other investigational work during recent years, generously withdrew from joint authorship of the new edition. The arrangement of the matter is the same as in the first edition, but with fifty-three additional pages of text (apart from the bibliography) and two new chapters. Significant of the notable extension of citrus planting outside of the United States during late years and the attention given by trained pathologists to the diseases and means of control, is the expansion of the chapter on the geographical distribution of citrus diseases from six to thirty pages.

A new chapter has been added on 'diseases due to deficiency or excess of inorganic constituents' in collaboration with Haas of California, and the parts treating of sweet orange and Australian scab and of citrus blight have been written with the help of Miss Jenkins of Washington and Rhoads of Florida respectively. Descriptions are given of about a score of diseases either not mentioned at all or only cursorily dealt with in the first edition; among these Mal Secco, a specific disease as understood now (due to *Deuterophoma tracheiphila* Petri), and of serious moment in the lemon plantations of eastern Sicily, is probably the most outstanding. Of the diseases fully treated in the first edition, Fawcett now records that no cases of canker (caused by *Bacterium citri* (Hasse) Doidge) have been detected in Florida since 1927, and that it appears to have been eradicated from all commercial plantings in the other Gulf States. The great campaign aiming at the total eradication of canker, begun in Florida in 1914 and extended to the neighbouring States, seems, therefore, to have been wholly successful: it has cost about two and a half million dollars. A similar campaign of eradication against canker in the Union of South Africa, begun in 1918, has been equally successful. These two effective campaigns against a highly infectious disease (the very susceptible grapefruit was the variety mainly concerned), seem destined to become classical in the history of plant disease control.

The author presents strong evidence, based mainly upon his own investigations, in support of the view that psorosis, a disease of wide distribution, the etiology of which baffled pathologists for many years, is due to a virus.

The bibliography has been enlarged from seventeen to forty-one pages, due in part to the filling of gaps in the references recorded in the first edition and to the very complete list of those of the last ten years (to the end of 1935).

The make-up of the book corresponds with the high standard of the first edition; the plates in colour, remarkable products of the technique of reproduction, are the same as those in the earlier edition. Should the new edition be reprinted, it would seem an added convenience if the plates could be numbered and listed in the table of contents.

Physiology of the Parasitic Nematodes

Nematodes Parasitic in Animals
By Dr. Geoffrey Lapage. (Methuen's Monographs on Biological Subjects.) Pp. x + 172. (London: Methuen and Co., Ltd., 1937.) 4*s*. 6*d*. net.

THE scope of this excellent little book is not, as its title might suggest, systematic or faunistic. It is addressed primarily to the experimental biologist, and the author's chief concern is with the physiology of the parasitic Nematodes, upon which, as he points out, their relationships with their hosts depend, and a better knowledge of which might enable us to control their harmful activities in man and domestic animals.

There is an introductory chapter on the structure, life-histories and classification of the group. Here, in so condensed a work, it is perhaps inevitable that a few errors and questionable statements should creep in. It is doubtful whether "most nematodes are parasitic"; while it seems a pity to find the common misspelling of Filarioidea as "Filaroidea" constantly repeated.

The main part of the book, however, is a useful review of the mass of recent literature dealing with the mode of life and metabolism of the Nematodes, their effects on their hosts and the problems of resistance to infestation. A bibliography of more than 400 references is given. His review leads the author to the conclusion that "in spite of every effort, no efficient control of any nematode parasitic in animals is known. . . . Work, therefore, which seeks to understand the physiology of nematodes is urgently needed. . . . No group of animals presents problems more interesting to the experimental biologist, nor a challenge more exacting to his skill. . . . If every biological laboratory in the world employed one experimental biologist on the study of parasitic nematodes, the reproach that neither biology nor medicine can cope with these parasites would soon be removed."

Our great ignorance of the physiology of these organisms, in spite of the work that has been done on them, is well brought out. The difficulties in the way of exact experiment are great. No one has yet been able to keep alive a Nematode parasitic in a warm-blooded animal, outside its host, for more than a few days. It is also very difficult to exclude bacteria and other contaminating factors. As Dr. Lapage says, "the products of nematode-metabolism cannot be accurately determined until a completely sterile nematode can be studied".

After discussing the known facts concerning the resistance of animals to infestation with Nematodes, the author says that "the available evidence suggests that . . . the three kinds of resistance are different only in degree and not in kind", and is of the opinion that comparisons between such resistance and bacteriological immunity should be made with caution. Some possible methods of controlling infestation, mainly in grazing stock, are briefly discussed in the last chapter.

H. A. B.

Practical Hints in Horticulture

The Horticultural Note Book: a Manual of Practical Rules, Data and Tables, for the use of Students, Gardeners, Nurserymen and others interested in Flower, Fruit and Vegetable Culture or in the Laying-out and Management of Gardens. Compiled by J. C. Newsham. Fifth impression. Pp. xx + 418. (London: The Technical Press, Ltd., 1937.) 7*s.* 6*d.* net.

THE new edition of this book follows on the lines laid down by its author in the original work. For conciseness and lucidity in pocket-book form, it would be hard to improve upon. Its data and practical details can be fully relied upon and the wealth of information crowded into its 418 pages covers the whole of the operations of any up-to-date garden. In this respect the author has a genius for imparting—in tabloid form—his wide knowledge to others.

A very large number of subjects bearing upon horticulture are ably dealt with. There are chapters on such widely different items as weights and measures, sizes of pots, land measures in detail, valuable information and full descriptions on the formation of kitchen and fruit gardens, lists of plants for each, costs of digging, trenching and drainage. The making of lawns and their upkeep, lists of grasses to use in various soils, buildings, sheds, fruit rooms, greenhouses and heating apparatus, are all dealt with separately in a thorough and practical manner.

Soils and geological formations are given a full chapter, and the chemical contents of various soils and manures are clearly defined.

Propagation by seeds, layers, grafts and cuttings is described in detail. There is a long chapter on fruit culture, which includes a useful list of varieties of all the best fruits grown in the British Isles. The best stocks to use for grafting, planting of various fruits, choice of sites suitable for each kind, picking, storing and even details as to packing and marketing are all fully discussed. No important item or detail has been left out and the whole work is brimful of most valuable information, all collected together under separate headings, and very easy to look up by the aid of a full and complete index.

In the 92 pages devoted to flowers and their culture, full lists of plants for the herbaceous border, greenhouse, stove and house decoration are given, and a feature of this is that all the principal florists' flowers are dealt with separately, with valuable notes on the time of flowering, height and colour of the flowers. A select list of ferns for stove, greenhouse and hardy conditions; cultural notes on orchids; lists of trees and shrubs for various soils and conditions; notes on economic plants; weeds of various kinds, and notes on the best method of eradication are included; also, the rotation of crops, and even such out-of-the-way subjects as "The Natural Food of Wild Birds"; "Points to be Observed in Judging"; "The Economic Value of Timbers", and a whole chapter on "Insecticides and Fungicides".

For its size and completeness, there is nothing like this book as a valuable aid to both the amateur and professional gardener, and it is one that should be on every garden-lover's bookshelf.

The Nation's Intelligence

By J. L. Gray. (Changing World Library.) Pp. iv + 154. (London: Watts and Co., 1936.) 2*s*. 6*d*. net.

The Menace of British Depopulation

By Dr. G. F. McCleary. Pp. 148. (London: George Allen and Unwin, Ltd., 1937.) 4*s*. 6*d*. net.

These two books, both conceived on scientific lines, and both written in the scientific spirit, are concerned with two momentous issues. One of them asks the question: Are we heading for national stupidity? The other asks the still more stirring question: Are we heading for national suicide?

In dealing with the first of these questions, Mr. Gray confronts the school of writers who hold that the offspring of the prosperous classes are on the average abler than the children of the poor in virtue of their superior mental inheritance, and who do not shrink from the inference that our high expenditure on social services, including education, simply encourages the perpetuation of inferior types, and ought, therefore, to be restricted. Arguing, as we have said, on strictly scientific lines, and without any social and political prejudices, Mr. Gray gives reasons for believing that there is no cause for alarm, that there is no ground for supposing that the average intelligence of the community is decreasing, and that, so far from being a blunder, the raising of the physical and intellectual level of the masses is of vital importance.

As to the menace of depopulation, Dr. McCleary sounds the definite note of warning. The population of Great Britain is still increasing, but at a rate so greatly reduced as to point to the beginning of decrease in the near future. If, says he, our present fertility and mortality rates remain at their present level, we shall enter upon a period of decline which must end in extinction. Most people, by the way, do not realize the position, because they are misled by an unscientific and superficial view of the relevant statistics. As the same process is going on in most of the Overseas Dominions of the British Empire, and as the mother country will soon be able to do nothing to help them, the outlook for the Empire is a black one. The author is in no doubt that the main cause of the decline is voluntary birth-control. He sees little hope of stimulating the growth of population by such artificial expedients as family allowances and marriage loans. Yet he does not close on a note of despair. The effective remedy, he holds, lies in making life better worth living for all classes of the community.

Vakuumspektroskopie

Von Dr. Hans Bomke. Pp. x + 248. (Leipzig: Johann Ambrosius Barth, 1937.) 17.70 gold marks.

Since the publication of Lyman's monograph "Spectroscopy of the Extreme Ultra Violet", there has been a steady development of technique and accumulation of results in the field of vacuum spectroscopy. Improved glass gratings and the use of grazing incidence have enabled the limit of the spectrum to be pushed to shorter wave-lengths, until now it is well within the long-wave limit of soft X-rays. Many spectra have already been studied. It has thus become desirable that a new survey should be made of the investigations which have been carried out in this field. In his valuable little book "Vakuumspektroskopie" Dr. Hans Bomke has set himself this task.

Dr. Bomke opens with a brief historical review, then proceeds to describe in considerable detail the design of various types of vacuum spectrographs, their method of use and the construction of light sources suitable for them. About two thirds of the book are devoted to these topics. The remaining third is concerned chiefly with work which has been done on the spectra of atoms, although eight pages at the end briefly summarize results obtained with molecules and solid bodies. The appendix contains useful constants and a very full bibliography.

This book should prove of great assistance to those desirous of becoming acquainted with recent researches in the extreme ultra-violet.

A Text-Book of Inorganic Chemistry

Edited by Dr. J. Newton Friend. Vol. 11: Organometallic Compounds. Part 4: Derivatives of Selenium, Tellurium, Chromium and Platinum. By Archibald Edwin Goddard. Pp. xxviii + 292. (London: Charles Griffin and Co., Ltd., 1937.) 20*s*. net.

The subject-matter of the present volume is concerned with the aliphatic and aromatic derivatives of selenium and tellurium and the organic compounds of chromium and platinum. It is almost entirely of interest from the point of view of organic chemistry, and it may be suggested that vol. 11, dealing with organo-metallic compounds, four parts of which making up a total of 1,632 pages have already been published, is out of proportion with the rest of the work. In the present volume, very minute details of preparation are given and the text will be of interest mainly to the specialist. The literature appears to have been very well covered and there are good indexes. For those who wish to inform themselves of the subject of which it treats the book will be a very useful guide. The preparations are nearly always given in sufficient detail to make reference to the original publications unnecessary.

Practical Stereoscopic Photography

By J. Moir Dalzell. Pp. xv + 224. (London: The Technical Press, Ltd., 1936.) 10*s*. 6*d*. net.

Dr. Moir Dalzell's book deals with the minutiæ of a single branch of photography. The subject is for the most part clearly treated, but the complete absence of illustrations renders some parts difficult to follow. In the early chapters the author discusses the characteristics of binocular vision, describing the psychological effects of various muscular actions and their relation to our interpretation of what we see. There follows a very complete treatment of apparatus and technique. Much of the part dealing with technique is applicable to general photography, and will be found very valuable to the 'one lens' workers as well as to stereo workers.

The Voyages of the *Discovery**

About forty years ago, the first *Discovery* lay abuilding in Stephen's yard at Dundee, for Captain Scott's Antarctic Expedition. She was built like a Dundee whaler, but of the finest African oak, and finished as a labour of love ; her timbers, spars and full barque-rigging were all as strong as Stephen and his men could make them ; but the old lines were not left unaltered, and when she put to sea she rolled terribly. The Hudson's Bay Co. got her later on, and the Colonial Office took her over when she was five and twenty years old and sent her on her first and last cruise to the Falklands and the South Georgian whaling-grounds. She found other Antarctic work to do under the Australian and New Zealand Governments, when our Colonial Office built a new ship under her old name, less beautiful, but equipped as no other ship had ever been for the naturalist and the hydrographer. A much smaller vessel was added later on, bearing the name of that great scientific navigator and whale-fisher William Scoresby. She was built as a "whale-catcher", to study and mark the whale at close quarters ; the Norwegian whaling-skippers at Walfisch Bay (when I happened once to pass thereby) thought they could have built her a great deal better ; but still she has marked her whales, and done good work in other ways.

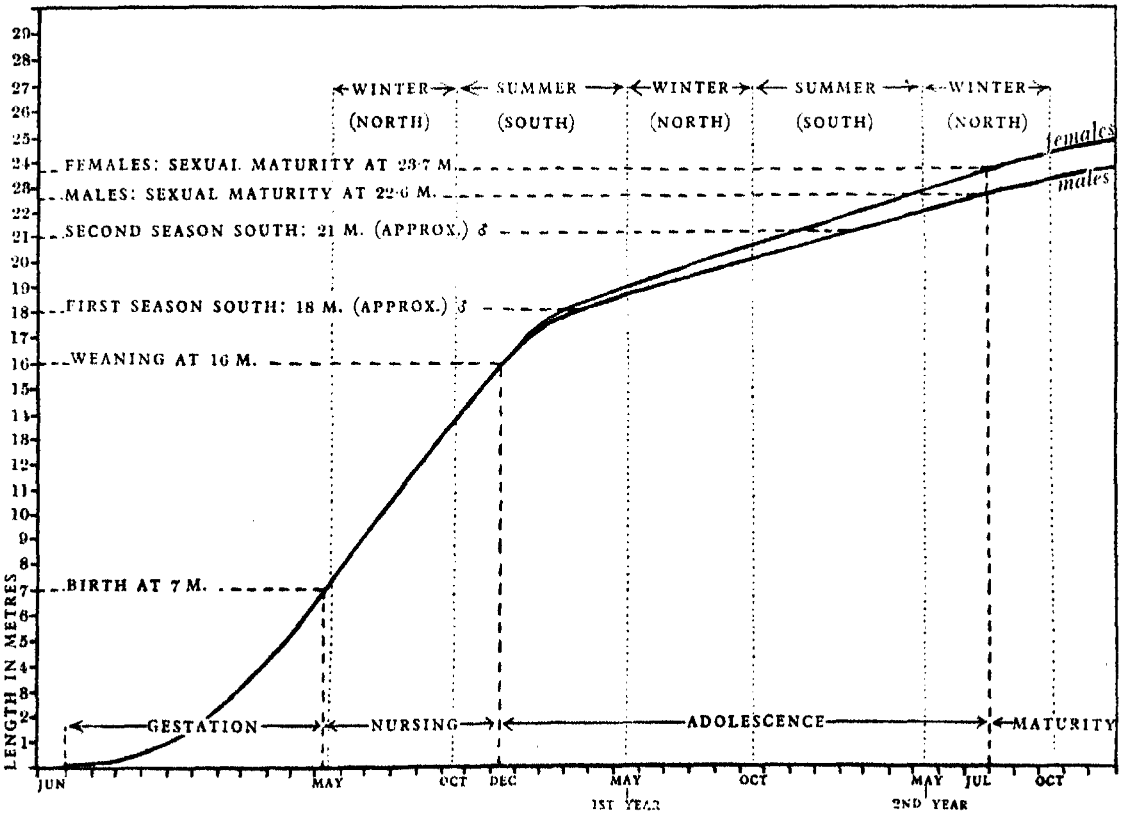

Fig. 1.

EARLY LIFE OF THE BLUE WHALE. FROM "REPORT ON THE PROGRESS OF THE DISCOVERY COMMITTEE'S INVESTIGATIONS".

The old and new *Discovery* and their little sister-ship have been at work on and off pretty steadily for twelve years in the fierce cold and almost constant gales of Antarctic seas. Their one main object was to study, for the sake of the whale-fishery, the natural history of the several whales, their movements and migrations, the things on which they feed, the waters in which they live and move; physical oceanography, chemistry and all the biological sciences have their part in the story of the whale. The Basque harpooneers in the Bay of Biscay killed out the Atlantic whales, one by one, until no more were seen for near a hundred years; the New Bedford men chased the Sperm whale all round the world, with ever-lessening catches; the Dundee ships in Davis Straits pursued the dwindling Greenland whale to the very verge of extinction. But the modern whaler, with his Svend-Foyn gun, his explosive bullets, and his 'floating factories', kills a hundred whales to the old harpooneers' one; and it was plain to see that, plentiful as whales were on their southern feeding-grounds, they could not outlast the insatiable pursuit for ever. The aim of the *Discovery* was "to furnish a basis for the rational regulation of whaling"; in other words, to tell the commercial world how far greed might safely go. The whale is a very different thing, say, to a codfish, which lays, year by year at random, its million eggs; the whale nurses its single child for months with all solicitude, but men of business slaughter it as the Red Men killed the buffalo, and no humanitarian considerations enter the case.

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* Report on the Progress of the Discovery Committee's Investigations. Pp. 52+11 plates. (London : Colonial Office, 1937.) 3s. 6d. net.

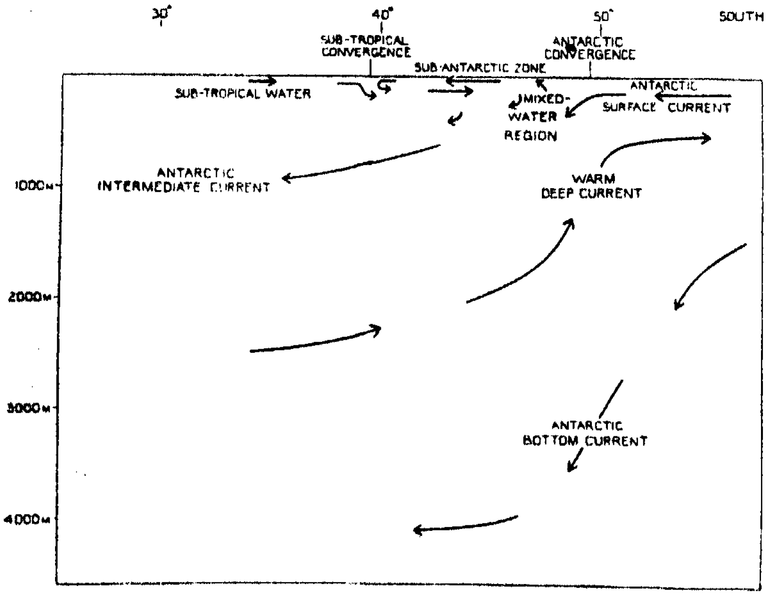

Fig. 2.

OCEANIC CIRCULATION IN THE SOUTHERN HEMISPHERE. FROM "REPORT ON THE PROGRESS OF THE DISCOVERY COMMITTEE'S INVESTIGATIONS".

The Blue whale, or Sibbald's whale as it was until lately called (after the old Edinburgh physician of three hundred years ago), is the largest and most valuable, the Fin whale (or common rorqual) the most abundant whale in the Antarctic; the rarer Humpback was the first to show grave signs of depletion. Some 10,000 Blue whales are killed every year down in the Antarctic, besides a good many more (younger on the whole) on the South African coast; and, if the numbers killed do not yet become noticeably less, the mean size falls away, little by little and year by year. The whales do not live so long, their 'expectation of life' grows significantly less; worse still, the mean size over the whole catch is falling below that of first maturity—a larger and larger proportion of the remaining stock no longer breed at all! The Blue whale is about 21 ft. long at birth, nearly 60 ft. long (so it is said) at a year old, and the females are sexually mature a little over two years old, when they are about 79–80 ft. long. This very rapid growth and very early maturity (on which the hopes and prospects of the fishery largely depend) are vouched for by the *Discovery* naturalists, and are in harmony with Norwegian estimates; they are novel, and unexpected, and extremely interesting determinations. Papers by Dr. Stanley Kemp, Dr. N. A. Mackintosh, Mr. J. F. G. Wheeler and Mr. A. Laurie on the Blue and Finner whales, their rate of growth, their age at maturity, their migrations, their estimated numbers, their curious physiology of respiration and all else about them, are here as large instalments of the work which the *Discovery* set out to do.

The *Discovery's* hydrographic work has proved peculiarly interesting, and Mr. G. E. R. Deacon deserves especial congratulation. Oceanography had its roots in the *Challenger* Expedition, its seeds were sown by Humboldt and Maury, but the tree only began to grow apace some thirty or forty years ago; it was then that Nansen told us something of the peculiar oceanographic interest of the polar seas. The *Challenger* had given us, as a first approximation, the simple story of a bottom-current, cold and heavy, flowing towards the equator, while a surface-current, salt and warm, streamed over it to the pole. That the great oceans show a more complex stratification than this was indicated even by the *Challenger* observations, as Merz saw long afterwards; but the Edinburgh physicists were cautious men, and had been afraid to trust to what seemed the too complicated evidence of their own thermometers.

Now the *Discovery*, following on the *Meteor's* work, gives us a new story just a little less simple than the old, telling of four water-layers in the oceanic circulation instead of two. Starting out from the Weddell Sea, toppling to begin with over the edge of the plateau, down to the bottom and away northward, goes a current of cold heavy water. Lying over this and creeping slowly southward, a mass of warm salt water lies ; it rises up over the Antarctic current as this plunges down to the depths on its northward way, but it does not come to the surface, for there is other Antarctic water there with a density so far reduced by melting ice as to float, cold as it is, over the warm deep current. Then over all comes the fourth layer, of tropical or subtropical water, very salt but very warm, flowing southward over all the Antarctic waters.

The whole case, simple as it is, is not quite so simple as that ! For our two surface-waters, the hot and the cold, the salt and the fresh, one going south and one coming north, meet somewhere, and when two water-masses meet things happen. You may see almost anywhere near the shore, especially in an estuary when the tide is coming in, a line of frothy turbulent water, marked out by a flotsam of sticks and straws ; this is the *Schaumrand*, as Otto Petterson called it. Such a *Schaumrand* on a prodigious scale, visible from miles away, marks somewhere about 50° S. the so-called "Antarctic Convergence", the meeting of the warm and cold surface-waters. Here the south-going current is turned back or carried down, and mixes with the Antarctic surface-water which meets it, to form, some way below, the cold northward intermediate current. Thus in the farthest south we have *three* layers of water—cold, warm and cold again ; but farther north there are *four* layers, tropical or subtropical ocean-water drifting southward over the other three.

From this easy beginning the story goes on and gathers interest. It is one of Deacon's remarkable discoveries that the Weddell Sea, and that alone, is the source of all the heavy bottom-water, heavy with cold and undiluted by melting ice ; from the Weddell Sea the drift creeps along at the bottom of the great oceans, and is traceable even as far as the Bay of Biscay. But there are parts of the Antarctic Ocean so barred by shoals or submarine walls as to be shut off from the main current-system. Ross's Sea has a northern wall so high that the warm deep current does not enter it at all. So Ross's Sea becomes filled up with Antarctic water, extremely cold, and also extremely salt because much water has been removed to form pack-ice ; and the fauna of Ross's Sea has (I believe) its consequent peculiarities.

Surface-currents coming northward from the far south hug the west coasts of the great continents, and the most important and best-known of these, which the *William Scoresby* has specially investigated, is the Peru or Humboldt Current. It flows for more than 2000 miles along by Chile and Peru, now slow, now swift, now narrow and widening out again, even to a breadth of some 200 miles. It seems to arise about 40° S., in one of those convergences or divergences of which we have spoken, where cool and moderately saline water of Antarctic origin wells up from below the warm water of the equatorial counter-current, as indeed it continues to do for all its length along the western edge of the continent. The cold water comes up teeming with nutrient salts ; it breeds a plankton-fauna of the richest kind ; and this supports a population of whales, and of fishes preyed on by innumerable sea birds the guano of which is sent all over the world. This cold current dominates the situation, but now and then persistent northerly winds check it or thrust it aside. Then comes *el Niño*, a new warm current upsetting the old equilibrium ; the fish die in millions, the water stinks, the birds starve, the guano industry cries aloud. On the west coast of South Africa, at Walfisch Bay and Swakopmunde, the same phenomena occur.

After this fashion the *Discovery* reports lead us to many interesting things—interesting chemically and biologically—and arising out of the plain facts of oceanography. At the bottom of the Weddell Sea are found gypsum, calcium oxalate and calcium citrate, the last two especially being of obscure origin and unknown at the bottom of any other sea. A vast abundance of life, microscopic and macroscopic, strikes every naturalist in Arctic or Antarctic seas, and the coldest of Antarctic waters are the richest waters in the world. The biologist is apt to ascribe this abundance to superabundant oxygen, such as the cold waters can dissolve ; but that alone would not go far. The nutrient salts, the phosphates and nitrates, are the true limiting factors in the growth of that micro-vegetation with which the whole biological cycle begins. The tropical oceans are often very barren of these salts ; in our own latitudes there is never too much, and the burst of growth in spring uses up the supply leaving little or nothing to spare ; but the *Discovery* people have shown us that phosphates and nitrates are more abundant in the Antarctic Ocean than in any other seas, and that down there plant-growth is never checked for want of them. Plant-growth in the ocean is limited to a certain depth by its need of sunlight, so the water a little lower down tends to be rich in unused phosphates. In the neighbourhood of any great divergence these waters rise to the surface, and foster an unusual micro-vegetation there. At the edge of the continental shelf we meet with such rising waters, and have again a richer growth of plants and of creatures great and small to feed on them and one another.

A hundred years ago, Johannes Müller was using the first tow-net, about the time when Edward Forbes was borrowing for the first time a fisherman's oyster-dredge; but only now do we begin to understand properly the importance of the floating life of the sea. Its distribution, its seasonal abundance, its variation with temperature, its presence in this water and absence in that, the vast variety of organisms of which it is variously and with varying importance composed, all these things are a great part of the science of the sea and of our understanding of all the fisheries. Prof. A. C. Hardy of Hull (a most ingenious student of the plankton) and Mr. E. R. Gunther have written an interesting report on the ways and means by which plankton is dispersed and distributed, and how the gathering-places of the whales may be expressed in terms of plankton, and again of the phosphate supply. Dr. N. A. Mackintosh has demonstrated a seasonal circulation in the Antarctic plankton on a scale unrivalled elsewhere; the big Euphausias, staple food of the Blue whale, first made known by the *Challenger* and met with again by Dundee whalers who went far south unsuccessfully some forty years ago, are fully described by Dr. F. C. Fraser and Mr. Dilwyn John. But without saying more of the ship's company and their doings, let me just say that the *Discovery II*, with a great task to do and ample means to help to do it, has added largely and handsomely to natural knowledge, and given the ship's name an honourable place among voyages of exploration and discovery. There is one omission in the report before us. I have read it all through without encountering the name (save in a list of papers) of the leader and director of the Expedition, the distinguished author of the report.

D. W. T.

Tests in Common Use for the Diagnosis of Colour Defect[*]

By Dr. Mary Collins

TESTS for colour vision fall into two categories. In one type of test, transmitted light is used, in the other reflected light. While the former type of test is regarded as the more fundamental, the latter can be of great service for quick diagnosis of colour anomaly. Colour tests may be administered purely for theoretical purposes, or they may be applied for practical purposes, as selection tests for different vocations. This second function assumes its most important role in vocations in which lack of accurate discrimination between different coloured signals may involve human lives. This function is also of significance in other vocations in which the lack of colour discrimination, though not involving danger to the community, is highly disadvantageous to its possessor.

There seems to be no need at the present day to emphasize the importance of the recognition and detection of colour defect. It is, however, very illuminating to study some of the more recent investigations in the field, particularly those concerned with the incidence of red-green defect. The percentages given seem to be much higher than in the reports of the earlier investigations. It does not necessarily follow that the incidence of the defect is increasing; the indications are rather that detection is more accurate owing to the improvement of the test material. Out of 360 candidates applying for acceptance as apprentice printers, the percentage of red-green colour-blinds was 7·5, this figure being exclusive of the colour-weak and the anomalous.

It seems more or less agreed that red-green colour-blindness is a reduction system of normal colour vision, one cogent argument in support of this contention being that normal colour matches are valid for any type of dichromate. The colour-blinds lack something which the normal eye has, but have nothing which the normal eye does not possess. The individual with normal colour vision sees a spectrum composed of six or seven colours. The red-green colour-blind has a spectrum composed of only two colours, these two colours being yellow and blue. The acceptance of this fact was delayed for a long time, and it is doubtful if it is yet generally accepted. Herschel, in 1845, was the first to put forward the dichromic explanation of colour-blindness. He pointed out in his article on "Light" in the "Encyclopædia Metropolitana" that certain individuals could only distinguish two colours, and that these two colours were yellow and blue. Clerk Maxwell, among others, opposed this, for he accepted the theory put forward at that time by Young and Helmholtz that colour-blinds were either red-blind, green-blind or violet-blind, and that the red-blind were blind to red, but could see the remaining two colours, green and violet: the green-blind were blind to green, but could see red and violet.

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[*] From the presidential address to Section J (Psychology) of the British Association, delivered at Nottingham on September 8.

In an account by Pole of his own case, we find he vigorously protests against these prevailing beliefs, and gives a careful analysis of his own colour vision as evidence. He had been pronounced red-blind by Maxwell and green-blind by Holmgren. Pole repudiated both suggestions, and claimed that the true solution was that he was blind to both colours. This conclusion was confirmed by a large number of facts. One was the evidence of the colour-blinds themselves who, whether they were classified as red-blind or green-blind, asserted that their colour sense was composed of blue and yellow. Another was a case of congenital unilateral dichromatism investigated by von Hippel in 1880. The individual tested had normal colour vision in his left eye but was colour-blind in his right eye. With the right eye he confused red and green with yellow, as tested by various standard tests. The colours which the subject could distinguish with his right eye were blue and yellow, these being confirmed when he looked at them with his normal eye. Von Hippel diagnosed the case as one of red-green blindness with spectrum of normal length. Holmgren examined the case with his wool test and proclaimed it to be one of red-blindness with shortened spectrum in accordance with the Helmholtz theory. Von Hippel retested his subject and reaffirmed his finding. This was the first case of monocular colour vision reported, and it undoubtedly strengthened the case for the acceptance of Herschel's and Pole's views. Holmgren, it is interesting to note, ultimately agreed that blue and yellow were the only colours seen. That this point is still controversial may be gathered from the statement made by Pitt in a recent investigation, that the fundamental responses of the protanope are blue and a saturated green, while those of the deuteranope are blue and a mixture of red and green.

Only a few cases of unilateral colour-blindness have been recorded, and these, according to Parsons, are of "doubtful value". In these cases, however, the suggestion is always that the colours seen are blue and yellow. Miles and Beaumont, who tested the two eyes separately in an investigation into colour-blindness, found considerable difference between the two eyes in many cases, and suggest that although there is no conclusive evidence as to the frequency of unilateral colour-blindness, "possibly it amounts to three or four per cent of the colour-blind". They discovered one such case in a group of 23, and Miles and Craig found another in a group of 390 mercantile salesmen. This latter individual was a dry goods salesman and aware of his condition, and if required to match fabrics he closed the defective eye and made the proper discrimination with his normal eye. If these cases of unilateral colour-blindness are as numerous as suggested, a field seems opened up for further investigation which may lead to definite conclusions as regards the fundamental sensations of the red-green colour-blind.

The results of investigations carried out over a number of years at Edinburgh into the colour-sensations of the red-green colour-blind seem to indicate that their colour sensations are indeed blue and yellow. The extent to which these two colours replace all the other colours in the spectrum is, however, not constant for every colour-blind. With some, yellow and blue may replace all the other colours, that is, red, orange, yellow and green may be seen as different shades of yellow, blue and violet as different shades of blue. Sometimes, instead of the green being replaced by yellow, it may appear as grey, or the blue-green may appear as grey, the extent of the neutral band varying with the gravity of the defect. A second neutral band is also found extra-spectrally in the complementary colour, in the purples. In one extreme case which came under observation, only two narrow bands of yellow and blue existed, the other colours being seen as shades of grey. Red appeared as black, orange as dark grey, yellow could be discriminated, green and blue-green were seen as grey, blue could be distinguished, but violet appeared as dark grey. In one test, out of 76 colours observed, 64 of them appeared as grey.

All cases, however, are not so extreme as the one just described, and the general finding which seems to be gradually gaining ground is that there exist different degrees of colour-blindness extending from extreme cases in which blue and yellow are the only two colours visible, to milder cases in which the blindness to red and green is not total. In these milder cases the individual can see red and green if they are bright enough or vivid enough. It is these milder forms which constitute the great practical problem, for in these cases the ability to distinguish between red and green is likely to fail when the individuals are fatigued, or when the illumination is poor, as in mist or fog. The extreme cases can be easily detected, but the milder cases, which have been described as 'dangerous colour-blinds', require very careful examination if they are to be detected.

That different degrees of colour-blindness exist has been emphasized by more than one writer. Hayes "wonders if we shall presently have to give up all classifications by types, arrange colour defectives in distribution tables and give a colour graph or profile for each subject, showing his efficiency or deficiency for each colour in terms of a per cent of the normal or average attainment". Troland states that the original restriction of colour-blinds to protanopes, deuteranopes and tritanopes is no longer adequate, and allowances must now be made for more types of variation. Edridge-Green recognizes seven different types of colour vision, and Schjelderup states that there are at least eighteen significant species of colour-blindness. Collins reaches the conclusion that it is quite unprofitable to try to classify the colour systems of the colour-blind because there exist so many individual variations.

One group in which the colour defect is not extreme has been definitely recognized. Seebeck, in 1837, found certain cases which he was reluctant to classify as colour-blinds, who yet showed signs of colour abnormality. It was not until 1881, however, that these cases were understood. In that year, Rayleigh found that a number of individuals with otherwise normal colour vision were unequally sensitive to red and green. In equating red (lithium line 670·8 $\mu\mu$) and green (thallium line 535 $\mu\mu$) to match a yellow (sodium line 589 $\mu\mu$), since known as the Rayleigh equation, some were found to require far more red than the normal, others required an excess of green. Von Kries, in describing an extensive series of experiments, applied the name 'anomalous trichromates' to these cases, and this designation has gained universal currency. Guttman advocated the terms red-weak and green-weak, and distinguished seven characteristics which they manifest, the chief of which are high thresholds, heightened colour contrast and a quick fatigue to colour stimuli.

It is customary to divide these anomalous trichromates into two groups corresponding to the two groups of dichromates, deuteranomalous trichromates or partial deuteranopes in which the sensitivity to green is below normal, and protanomalous trichromates or partial protanopes in which the sensitivity to red is below normal. The green anomalous seem to be more numerous than the red anomalous, the ratio being quoted as 5 to 1.

These cases, it may be, form the connecting link between normal colour vision on one hand and colour defect on the other, and if a sufficient number of cases could be tested ranging from normality to complete red-green deficiency, a continuous series might be obtained.

It is a moot point as to whether these anomalous trichromates form 'dangerous colour-blinds'. The general finding seems to be in favour of the affirmative. Some writers, for example, Troland, actually include them in classifications of types of colour-blindness. Oblath points out that they can only recognize colours when they are saturated and of intense luminosity ; "It is evident that these peculiarities render these subjects less fitted for certain services". In a report on "Colour Vision Requirements in the Royal Navy" (Med. Res. Council Report, Spec. Series No. 185 ; 1933), it is stated that "the mildly anomalous trichromate can be considered a safe look-out. On the other hand, the unfit anomalous trichromate is, in many ways, a greater source of danger than the dichromate". The incidence of this anomaly is estimated, in the same report, as 6 per cent, which is stated to be a very conservative estimate. Both reports emphasize very strongly the fact that the anomalous trichromate behaves as if colour-blind when conditions are unfavourable, such as when mist, fog or smoke are present, and this is all the more disastrous because the individual is rarely aware that he suffers from any colour defect. The heightened contrast and the quick fatigue characteristic of such anomaly may well make the judgment of colour and the discrimination of colour highly erroneous. The testing and discovering of these cases of anomalous trichromatic vision is not easy, and necessitates very careful procedure, and generally not the application of one test, but of a battery of tests.

(To be continued.)

Obituary Notices

Sir David Orme Masson, K.B.E., F.R.S.

PROF. SIR DAVID ORME MASSON, who died at Melbourne on August 10, was born at Hampstead, London, on January 13, 1858. He was of mixed English and Scots descent. His father, Prof. David Masson, editor of Milton, Goldsmith and De Quincey, and Historiographer-Royal for Scotland, came of Aberdeenshire stock—there is a saying in the Don valley that "Eassons, Massons an' Kessons a' cam' frae Tarlandside". His mother, Rosaline Orme, had a forbear George Rutt, the father of Joseph Priestley's biographer, John Towill Rutt ; and it may be mentioned, as throwing some light on the family, that the home of the Ormes, in Avenue Road, Hampstead, was a favourite rallying ground of the Pre-Raphaelites. In 1865 David Masson migrated from the chair of English literature at University College, London, to the Regius chair of English in the University of Edinburgh, and so it came about that his son, David Orme Masson, was educated at Edinburgh Academy and afterwards graduated M.A. and B.Sc. at Edinburgh.

In his younger days Masson was a strong walker and swimmer, and he played golf, tennis and billiards. After a short period of research with Prof. Crum Brown, he left Edinburgh for Bristol in 1880, to become Prof. W. Ramsay's first assistant (in later days, his son, Irvine Masson, was to become Sir William Ramsay's last assistant, at University College, London). Before Masson returned to Crum Brown, he and Ramsay had laid the foundations of a lifelong friendship. Meanwhile he had acquired some further research experience at the University of Göttingen. During his second period at the University of Edinburgh, Masson, with R. Fitzroy Bell, founded the first Students' Representative Council in any university, of which Masson became the first Senior President. The ensuing revolutionary improvement in the students' behaviour at graduations, etc., led Principal Sir Alexander Grant to exclaim, at the end of the tercentenary celebrations: "Gentlemen, you have saved the Republic!" Masson was also a prime mover in the foundation of the Students' Union in the University of Edinburgh—again, the first in Great Britain.

In 1886 Masson was elected to the chair of chemistry in the University of Melbourne, a key appointment which he held with high distinction until he retired in 1923, to become professor emeritus. Orme Masson, and his contemporaries Baldwin Spencer and T. R. Lyle, must be numbered among the prime creators and moulders of Australian science; to them Australia in general and the University of Melbourne in particular owe a debt beyond computation. A brilliant and inspiring teacher, Masson built up Australia's most distinctive school of chemical research at Melbourne, and exerted a steady influence upon the development of Australian science through his pupils and research students; but this was only one side of his work. His remarkable clarity of vision, combined with his organizing and administrative ability, his interest in the wider aspects of science, and his flair for public work, naturally brought him out as a leader in the foundation of national scientific institutions in Australia. Among these were the Commonwealth Advisory Council of Science and Industry, of which he was deputy chairman from 1916 until 1920, and which merged later into the Commonwealth Council for Scientific and Industrial Research; the Australian National Research Council, of which he was president in 1922–26; and the Australian Chemical Institute, of which he was the original president in 1924. Masson was also president of the Australasian Association for the Advancement of Science in 1911–13, and was largely instrumental in bringing about the visit of the British Association to Australia in 1914. In addition to all this, he was active in the interests of Antarctic exploration from Australia.

Masson's researches were concerned chiefly with physical chemistry, more particularly with the theory of solutions, ionization, and chemical dynamics. With Ramsay, at Bristol, he worked upon atomic volumes at the boiling point[1]. This investigation was followed, at Edinburgh, by some work with M. Hay on the composition of nitroglycerine[2], and by a series of researches on sulphine salts, carried out partly in collaboration with L. Dobbin[3]. The latter theme was afterwards extended at Melbourne with J. B. Kirkland[4]. A paper on molecular volumes[5] was followed by another early research at Melbourne, in which, with N. T. M. Wilsmore, Masson came near discovering the celebrated organic synthetical reagents later associated with the name of Grignard[6].

In 1891 Masson pointed out the analogies between solution and vaporization which are embodied in his term 'critical solution temperature'; at the same time he brought to notice certain other principles regulating the miscibilities of liquids[7]. He was a keen exponent of the ionic theory in its early days, and between 1897 and 1899 he developed the direct 'jelly-tube' method of measuring ionic velocities[8]. Later notable work emanating from the Melbourne laboratories under his inspiration included various observations on the decomposition of persulphates and of sulphine hydroxides in aqueous solution (Leila Green, Brenda Sutherland[9]), and studies on the viscosity and conductivity of some aqueous solutions (W. Heber Green[10]). Another interesting research (1909), dealing with the mechanism of urea-formation from cyanates, was carried out in collaboration with his son, Irvine Masson[11]. During this period also, B. D. Steele and Kerr Grant[12] developed their quartz micro-balance in Masson's department; this was afterwards used by Ramsay and Whytlaw-Gray to measure the density of radium emanation.

It is not generally known that early in 1895 Masson evolved a modification of Mendeléeff's periodic system, which, apart from the treatment of the rare-earth metals, is practically identical with the later classification of Bohr. Masson's arrangement was printed immediately after Ramsay's discovery of helium[13], and it contained spaces which were later filled by neon, krypton, xenon, and niton. "Helium and Argon," it is stated in an inset to the table[14], "are placed in the new Group VIII, characterized by valence = 0 and atomicity = 1." It was probably a discussion between Masson and Ramsay in May, 1895, during a visit of Masson to Great Britain, which first gave Ramsay real confidence in the idea of this missing *group* of rare elements. Masson's arrangement was adopted by Ramsay and incorporated by him in a celebrated wall-diagram which he used in his lectures at University College, London (part of this diagram was reproduced in the well-known caricature of Ramsay by 'Spy').

Another example of Masson's prescience is provided by a paper published so early as 1921, in which he developed what was essentially a proton-electron statement of the composition of atoms and of the consequent form of the periodic classification[15]. This striking treatment of a fundamental problem failed to attract the attention it deserved. A similar remark applies to Masson's final contribution to physical chemistry. This work, which was summarized in a paper brought before the Australasian Association for the Advancement of Science in 1935, and afterwards printed, offered a new treatment of the facts of the electrolytic conductivity of strong and feeble electrolytes, in strong and weak solutions, from which Masson deduced a simple general law based upon the viscosity aspect.

Masson's direct contacts with industrial chemistry were limited, but a constant stream of his students went forth into industrial careers in Australia and elsewhere. Through the close touch which he maintained with his former students and their firms, he exerted a wide influence in this field, directed particularly towards the scientific management of industrial concerns. Among his old students who entered academic chemistry may be mentioned his own successors at Melbourne, Prof. (now Sir) A. C. D. Rivett and Prof. E. J. Hartung, and elsewhere Prof. L. S. Bagster, Dr. A. C. Cumming, Prof. J. I. O. Masson, the late Prof. B. D. Steele, and Prof. N. T. M. Wilsmore.

Masson's work received early recognition in his election to the Royal Society in 1903. He became C.B.E. in 1918, K.B.E. in 1923, and LL.D.(Edin.) in 1924. He married Mary, daughter of the late Prof. Sir John Struthers, M.D., of Aberdeen and Edinburgh, who survives him; of his two daughters one survives; and his only son, Irvine Masson, is professor of chemistry in the University of Durham.

David Orme Masson was a man of great charm and urbanity, with a rare gift of lucid exposition and a lively and polished wit. Modest, versatile, and cultured as befitted his ancestry, he possessed an unusually wide range of interests and human sympathies. He was the doyen of chemistry in Australia, a great teacher in the University of Melbourne, and a much-loved citizen of his adopted country.

JOHN READ.

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[1] *J. Chem. Soc.*, **39**, 49 (1881).

[2] *Trans. Roy. Soc. Edin.*, **32**, 87 (1883).

[3] *J. Chem. Soc.*, **47**, 56 (1885); **49**, 233, 249, 846 (1886).

[4] *J. Chem. Soc.*, **55**, 126, 135 (1889).

[5] *Phil. Mag.*, [5], **30**, 412 (1890).

[6] *Proc. Chem. Soc.*, **7**, 16 (1891).

[7] NATURE, **43**, 345 (1891); *Z. phys. Chem.*, **7**, 500 (1891).

[8] *Phil. Trans.*, A, **192**, 331 (1899).

[9] *J. Chem. Soc.*, **97**, 2088 (1910); **99**, 1174 (1911).

[10] *J. Chem. Soc.*, **93**, 2023, 2049 (1908).

[11] *Z. phys. Chem.*, **70**, 290 (1910).

[12] *Proc. Roy. Soc.*, A, **82**, 580 (1909).

[13] *J. Chem. Soc.*, **67**, 1107 (1895).

[14] Masson's table was published as a folding card by Melville, Mullen and Slade, London and Melbourne, n.d. A note states: "Atomic weights taken from the table of F. W. Clarke, revised to 1st January, 1895."

[15] *Phil. Mag.*, [6], **41**, 281 (1921).

Canon B. H. Streeter

CANON B. H. STREETER, provost of Queen's College, Oxford, who was killed with his wife in an aeroplane accident in Switzerland on September 10, was one of the great Biblical scholars of the world. He was a many-sided man, and his intellectual interest was wide. Psychology, modern physics, anthropology, psychical research, the relations between religion and science, were all subjects in which he had read widely and become interested. He had a large circle of friends from whom he could acquire at first hand the information on these subjects he needed. He was, in particular, profoundly alive to the difficulties raised by the relations of science to religious truth, and some of these were discussed by him in his most popular book, "Reality: A New Correlation of Science and Religion" (1926), more briefly also in "Adventure" (1927), and in the Bampton Lectures for 1932, "The Buddha and The Christ".

By 'religion' Streeter meant religion and not, as so often in similar discussions, theology. In religion as implying a quest for God, an apprehension of things beyond the limits of ordinary experience, he was a firm believer. In "Reality" he discussed the connexion between this and science, as he conceived it, clearly and simply. He held strongly that religion, like science and art, reveals to us genuine aspects of reality. Science, he said, gives us a representation of ultimate reality diagrammatic rather than pictorial; religion the reverse—it gives us the picture, not the exact diagram. The two aspects are there; in a sense they are complementary; they are not, however, commensurable. He put it in another way. Science is concerned with the metrical aspects of existence, religion (as art) with non-metrical or qualitative aspects, with values that are mostly ethical. Science states definitely; religion suggests. One tries to explain what is observed by finding laws covering individual cases; the other isolates an individual event or circumstance and makes it symbolic of some aspect of reality. For Streeter the truth of religion lay mainly in the quality of the myths (in the Greek sense) it embraces. The values enshrined or symbolized there are inherent in reality to the extent that the religion is true.

In the eighth Bampton Lecture Streeter, discussing psychical research, gave some of his own experiences of suggestion, mass-hypnotism and telepathy. In particular he discussed the 'levitation' of D. D. Home in 1871 witnessed by the Master of Lindsay and two friends present. He suggested from his own successful repetition of this exploit that Home probably gave each of the three a 'waking suggestion' which effectively convinced them that what they attested actually occurred.

Streeter was born at Croydon in 1874 and educated at King's College School. He went to Oxford as scholar of Queen's College in 1893 and thereafter spent most of his life there. As undergraduate he obtained three first classes and many university prizes. He was fellow of Pembroke from 1899 until 1905 and of his old college, Queen's, from 1905 until his appointment as provost in 1933. He was a fellow of the British Academy and honorary doctor of several universities. He married in 1910 but had no children.

A. S. R.

WE regret to announce the following deaths:

Dr. J. R. Airey, formerly principal of the City of Leeds Training College, on September 16, aged sixty-nine years.

Prof. de Burgh Birch, C.B., emeritus professor of physiology in the University of Leeds, on September 18, aged eighty-five years.

Mr. F. A. Potts, University lecturer in zoology in the University of Cambridge, on September 15.

News and Views

Prof. G. Barger, F.R.S.

THE appointment, which is announced elsewhere (p. 556) of Prof. G. Barger, professor of chemistry in relation to medicine at the University of Edinburgh, to the Regius chair of chemistry in the University of Glasgow, will give general satisfaction. By his work during the past thirty years, Prof. Barger has exercised a considerable influence on the development of organic chemistry and biochemistry in Great Britain. In his well-known early collaboration with Dr. (now Sir Henry) Dale, in the laboratories of Messrs. Burroughs, Wellcome and Co., he was jointly responsible for one of the most fruitful applications of organic chemistry to biological problems which has ever been made ; he is a distinguished worker in the field of alkaloid chemistry and by his own work and through his pupils he has made major contributions to what may be called in general terms organic biochemistry. Prof. Barger's appointment in 1919, after holding the professorship of chemistry at the Royal Holloway College, London, to the newly instituted chair of chemistry in relation to medicine at Edinburgh, was in itself a recognition of the outstanding characteristic of his work, namely, the attack of organic chemical problems related to biology not from a narrowly chemical point of view but with true appreciation of their biological implications. His Department at Edinburgh has continued to work on these lines, and has at the same time been responsible for great improvements in the teaching of chemistry to students of medicine. Prof. Barger's influence in chemistry to-day is further enhanced by the many contacts which he maintains with colleagues in other countries, aided as he is by linguistic attainments of distinction. It is encouraging to those who believe that organic chemistry has still vital contributions to make to biology that an important chair of chemistry such as that at Glasgow should be occupied by one who has shown the keenness of his biochemical interests by his own sustained efforts and through the work of his pupils.

Memorial to Samuel Smiles, LL.D.

IN the latter half of the last century a book called "Self Help" was widely read, and an indication of this is shown by its having been translated into twenty-two languages. It developed from a lecture given by Dr. Samuel Smiles in the old Cholera Hospital, Leeds, to a mutual improvement class of working men. Smiles was born in 1812 at Haddington and educated at the Burgh School and at the University of Edinburgh, where he qualified as a medical man. Not having sufficient patients, he wrote articles, and these were seen by the proprietor of the *Leeds Times* who in 1838 asked him to be editor. In 1842, having then "had enough of unquiet life of newspaper work", he set up as a surgeon in Holbeck, South Leeds. He was partly attracted there by the activities of a school and in his autobiography he says : "On Sundays I taught young men and sometimes gave addresses in Zion School, New Wortley." Smiles married the daughter of a Leeds contractor and in 1845 became secretary of the Leeds and Thirsk Railway, which was afterwards absorbed into the Midland Railway system. This occupation brought him into contact with engineers, and he began to collect data which later appeared in his five volumes of the "Lives of the Engineers" ; "Industrial Biography" ; "The Lives of George and Robert Stephenson", etc. By his writings and lectures, etc., he helped to create in the West Riding a strong public opinion on such questions as the repeal of the Corn Laws ; Parliamentary reform ; national education and free public libraries. Zion School was one of the first to have such a library. A memorial tablet in bronze is to be fixed on the old school building, and a set of his books has been presented by Sir John Murray, whose firm published them. Sir Walter D. Smiles, M.P., is also presenting an enlarged framed portrait. The organizer of the memorial is Mr. E. Kilburn Scott, of 38 Claremont Square, London, N.1.

"Shiva's Temple", Arizona

WIDESPREAD interest has been aroused by the investigation of "Shiva's Temple", in the Grand Canyon, Arizona, U.S.A., which is being explored by the Paterson-American Museum Grand Canyon Expedition, with Dr. Harold Anthony, curator of mammalology in the American Museum of Natural History, as its leader. Shiva's Temple, an isolated cliff of limestone, rises to a height of 1,200 feet above the floor of the Canyon, and is surmounted by a wooded plateau two hundred and seventy-five acres in extent, which is reputed never to have been visited by man since the cliff was separated from the mainland at some time about the close of the Ice Age. It was anticipated that forms of animal life, if any, surviving on the plateau after so lengthy a period of isolation might afford valuable evidence of adaptation and divergence. Dr. Anthony and Mr. Edwin McKee, chief naturalist of the Grand Canyon National Park, with six other members of the expedition, reached the plateau on September 16 after a three hours' climb. Shed antlers of deer were seen, as well as chipmunk, a rabbit and signs of coyote. The first specimens brought to the base camp were a pair of leaf-eared mice. Traps have been set for other animals by Dr. Anthony, who remained on the plateau when other members of the party returned to the base camp. Supplies were dropped from an aeroplane, including water, of which no trace has been found on the plateau. This makes it remarkable that the party should have been much troubled by mosquitoes.

IT would appear that before it was isolated, the plateau was a favourable hunting ground for early man. A number of stone arrow-heads and knives have been found. Unless these are the relics of an early party of adventurous climbers, which seems unlikely, they should help in assigning a date to the period of isolation, more especially if the arrow points should conform to the highly specialized type of stone implement known as the Folsom point, which is widely distributed over the High Lands of the south-western United States from Wyoming to New Mexico, though not yet found in characteristic form in Arizona. As mentioned below, stone implements have been found recently in South America in association with the extinct horse and giant ground sloth, while Folsom points have been found embedded in the bones of an extinct bison, as well as in association with that form and with the mammoth, at Folsom and Clovis in New Mexico and elsewhere. It is now beyond question that in certain parts of North America early man was contemporary with an extinct fauna which in Europe would justify a Pleistocene dating in the later part of the Ice Age. In America, however, it is generally conceded, the characteristic Pleistocene fauna, or at least certain members of it, may have survived to a much later date than in the Old World, while conditions militated against a very early appearance of man in the New. If the implements of Shiva's Temple are of the earliest type, and belong, as appears probable, to the pre-isolation period, they indicate on a conservative estimate an upward limit for the period of isolation of approximately ten thousand years, or possibly a little but not much more.

Ancient Man in Chile

AN expedition to Chile of the American Museum of Natural History, New York, extending over a period of two and a half years, is reported to have discovered a succession of stone age industries claimed to be of greater antiquity than any previously known in South America. More than four thousand stone implements, it is stated by Science Service, Washington, D.C., have been collected by Mr. and Mrs. Junius Bird, on behalf of the Museum, from two cave sites, Fell's Cave and Palli Aike Cave on the banks of the Rio Chico in southern Chile, near the Straits of Magellan. In the former of the two caves was a stratified succession of five cultures, of which the earliest included tanged spear-points, unique in South America, associated with the bones of the extinct horse and giant ground sloth. This culture was covered by a rockfall, while at Palli Aike, twenty miles away, the oldest culture period closes with a deposit of volcanic ash. Some considerable time after the fall of rock, Fell's Cave was again occupied by man. With the artefacts of this period are associated at first bones of the horse and ground sloth, and later of foxes, of which one form is extinct, and birds. The implements are cruder than those of the early stage. In this and the preceding period the animal bones have been split for the extraction of marrow and show the effects of fire. The succeeding culture introduces the bola, of which the carefully grooved weights have been found with the stone gravers used to make the grooves. Arrow points and knives appear with the bola in the fourth culture, which is dated tentatively at 2000 B.C. on comparative evidence. The last occupants of the cave, who show no affinity with their predecessors, were the possessors of a culture in many ways comparable with that of the Ona of Tierra del Fuego, who, up to a few years ago, used stone arrow-points similar to those found in the cave. The cave seems to have been abandoned before the Spanish conquest, as no bones of the horse then introduced into America have been found in it.

University Development at Birmingham

IT is reported that the University of Birmingham is selling the Mason College site, and the price is said to be £400,000. If the negotiations are satisfactorily completed, the long-desired transfer of the whole of the University to the Edgbaston site will soon be an accomplished fact, and the uneconomical and very inconvenient separation of the faculties will be a thing of the past. Already the building of the new medical school (between the great new hospital and the University at Edgbaston) is nearing completion, and it is hoped that the school will be ready for opening next year. Such an event would be a fitting crown to the work of the Vice-Chancellor (Sir Charles Grant Robertson) who has expressed his intention of retiring at the end of the coming session and who has taken a leading part in the establishment of both hospital and medical school. The money resulting from the sale of the Mason College site will also make possible the expansion, and improvement of the equipment, of some of the departments already at Edgbaston, the Physics Department in particular, which is at present partly housed in old Army huts, inconvenient and unsightly.

Health and the Community

IN the account of the discussion in Section I (Physiology) of the British Association on "Health and the Community", which appeared in NATURE of September 18, p. 493, it is stated on p. 494 that the safest rate of reproduction for both mother and offspring is the modal rate. The author of the article has asked us to point out that this statement holds for any size of family, but the example of modal rate actually given was for a family of seven. This does not bear the implication that seven is the ideal number per family. Actually the lowest mortality was found in families of three, produced *at the modal rate*. The author has also sent the following supplementary note. "One point in the discussion of immense importance for the future not only of the race but also threatening civilization itself, was not sufficiently stressed in the article, namely, the *differential* birth rate. It follows from the facts that the modal rate is, on the whole, observed only in the lowest paid members of the community, and that they start reproduction early (less than twenty years of age), that the number of the population below the poverty line, that is, those being maintained by the tax-payers, will steadily increase. In 1930, round about 10 per cent of the families had more than 40 per cent of the pregnancies, 45 per cent of the still-births, 53 per cent of the infant plus child mortalities and 63 per cent of the miscarriages. In 1950, the 10 per cent will have become at least 30 per cent. Nothing short of massacre can alter that now. Births cannot be retrospective. If nothing is done and the process goes on, in 1970, the submerged tenth will be multiplied by seven. This means that, apart altogether from the increasing load of old people, some 30 per cent of the population will have to face the problem of supporting the rest of the community."

The Short-Mayo Composite Aircraft

EXPERIMENTAL flights of the two units of this combination are proceeding successfully at Rochester. *Mercury*, a four-engined monoplane seaplane, which is to be attached to the top of, and launched from, *Maia*, a four-engined monoplane flying boat of a modified Empire type, have both flown separately, and have now to carry out trials, taking off, flying and landing as a combined unit. These will be followed by tests involving releasing in the air and landing as separate units, their normal functions. This experiment is one of fundamental importance in the problem of high-speed long-range flight, as it represents one of several possible methods of getting an aircraft into the air with a load which would make taking-off unsafe or even impossible for a machine under its own power. Heavy loads are not only economical from the transport point of view, but also high wing loading is essential for economical power consumption in high-speed flight. Reduction in engine power used not only reduces costs, but also increases the machine's range on a given fuel tank capacity. When this problem is successfully overcome, it will also help in the case of land aircraft, allowing the use of smaller aerodromes for large heavily loaded commercial machines.

ANOTHER point of the composite type of aircraft is that it will allow the engines of the launched machine to be of the supercharged type necessary for high altitude flying, without their having to carry the complications necessary to allow them to function efficiently at ground level, for the purpose of taking off, as well. Other methods of attaining the same object at present being developed are (1) the use of various wing attachments such as slots or flaps, wing surface and contour changing devices, variable pitch propellers, to increase the speed range of the aircraft, and (2) catapulting the machine into the air, giving it the speed necessary for flight with its high loading, from a momentum applied to it from an external source of power, usually either explosive or hydraulic.

Progress of Marine Engineering

ON September 14, Mr. S. J. Pigott, director-in-charge of the Clydebank Works of John Brown and Co., Ltd., where the *Queen Mary* was built, delivered the presidential address to the Institute of Marine Engineers. In the main it was a review of the development in marine engineering during the last sixty years. The era 1877–87, he said, might be designated "The Advent of Steel in Engineering". In that decade it was possible to raise the pressure in cylindrical boilers to 160 lb. per sq. in., and at the same time forced draught was introduced. The next decade, 1887–97, saw the development of the quadruple-expansion engine, which in the period 1897–1907 attained its maximum size. The year 1897 was also marked by the use by Sir Charles Parsons of the marine steam turbine, and in 1904 the Cunard Steamship Company equipped the *Carmania* with a high-pressure turbine driving a centre-line shaft and exhausting to a low-pressure turbine on each wing-shaft. The Diesel engine first made its appearance on shipboard in 1903 in the small Russian tanker *Vandal*. Another landmark was the fitting of geared turbines in the *Vespasian* in 1909. In 1910 impulse turbines as opposed to the earlier reaction turbines were fitted in H.M.S. *Bristol*, and to-day, the most highly powered British naval vessel, H.M.S. *Hood*, is propelled by impulse turbines with gearing. If the era 1927–37 has seen no epoch-making development, it has produced progressive designs as is seen in the cross-channel motor-ship *Prince Baudouin*, the turbo-electric P. and O. liner *Viceroy of India*, and last but not least the *Queen Mary* and *Normandie*.

Miniature Ball Bearings

AN invention which, apart from its intrinsic merits as a mechanical development, promises to be of especial interest in a scientific sense, is the introduction by a Swiss manufacturer of a range of miniature ball bearings. Ordinary bearings of this class have been made in sizes varying from half an inch to five feet in diameter overall; but nothing small enough has been available to satisfy the requirements of small and sensitive instruments. The bearings now obtainable as a result of this invention are of several different types and vary in size from 1 to 22 millimetres in diameter overall. They are thus of suitable size for use in such devices as small motors, recorders, meters, clockwork, tachometers and scientific instruments of many kinds in which measured movements are produced by infinitesimal forces, and friction must be eliminated as far as possible. Comparative tests on these bearings and the jewelled bearings they are intended to replace show advantages under three different modes of operation. The time to damp down a rotary motion was in some cases so high as eight times that when plain pivots were used and twenty times that when tapered pivots were used, though there is a good deal of variation in the results. In an oscillatory test the corresponding figures were about 4 and 15, while in the deviation test the results claimed are also favourable. As these new bearings are obtainable at moderate prices, it is probable that, after adequate trials, they will play an important part in the future construction of scientific instruments. They are being marketed by International Technical Developments, Ltd., Thames House, Millbank, London, S.W.1.

The Wettest Place in the British Isles

DR. J. GLASSPOOLE, in an article entitled "The Wettest Place in the British Isles", which appears in the *Meteorological Magazine* of July, seeks to end the false idea so commonly held that Seathwaite, in Borrowdale, is the wettest place in Great Britain. He points out that there are several small areas nearly twice as wet as Seathwaite, and suggests that the common error has lasted so long because meteorological literature has not provided definite figures to disprove it. This lack of precise information has been due to the lack of rain gauges near the summits of the highest mountains in the four wettest areas over which the average annual rainfall exceeds 150 inches—areas in Snowdonia, the English Lake District, on Ben Nevis, and at the head of the River Garry in the western highlands of Scotland. Dr. Glasspoole considers that in the light of records now available and a study of the relationship between average rainfall and the configuration of the land, estimates can be made of the maximum rainfall in each of the four areas. In Snowdonia we have Glaslyn, at 2,500 feet, with 198 inches, which is probably a little less than the figure for the summit, only about 500 yards away. In the Lake District it is thought that 185 inches is not exceeded in the wettest area, which includes Scafell and Scafell Pikes, while Ben Nevis, in spite of its greater elevation, is more isolated and in consequence offers less obstruction to the moisture-bearing winds, and its summit has a rainfall estimated at only about 165 inches. At the head of the River Garry, however, the fall on Sgurr na Ciche is thought to be comparable with that of the summit of Snowdon over a small area, namely, about 200 inches, compared with the 129 inches of Seathwaite Farm, which last is not even the wettest habitation in Great Britain.

Fortified Hill-top Site in Sussex

A FORTIFIED hill-top site on Mount Caburn, one mile north of Glynde, near Lewes, has been partially excavated by Dr. A. E. Wilson of Brighton Grammar School with the assistance of Dr. E. Cecil Curwen. Since July, it is reported in *The Times* of September 14, portions of the outer and inner ramparts and a length of Iron Age road, with three gateways, have been uncovered. Of the gateways, one on the north side of the town, where the slope is comparatively easy, is of considerable size and is provided with re-entrant ramparts on either side for purposes of defence. A number of sling stones were found. The steep slope of the south side was defended by ramparts and a deep ditch. There are indications in the ceramic evidence that the site was first occupied about 500 B.C., and was fortified about two hundred years later. Stratification revealed by trenching suggests two periods of reconstruction, one about 50 B.C., when the main gate was moved a few feet forward, and a second about one hundred years later, when a second gate, forming a sort of barbican, was added. Piles of ash near this gate may be, it is conjectured, either a relic of the process of hardening the ends of oak stakes to be driven into the ground, or evidence that the town was destroyed by fire. Flint kerbs mark the edges of the Iron Age roadway, of which the surface is reinforced by flints at a distance of four feet six inches apart, indicating that the gauge of the prehistoric cart was approximately the same as that of the modern cart. One of the ramparts shows what appears to be an early attempt to mix a concrete, powdered chalk apparently being mixed with water and rubble. A grant of £20 made by the Sussex Archæological Society has made it possible to continue the work of excavation until the end of October.

Prehistoric Finds at Glasgow

EVIDENCE, it is claimed, indicating the site of a wooden circle, or temple, the largest of its kind yet known, has been found at Knappers, on the Duntocher Boulevard, Glasgow. The site has been under investigation for some weeks by Mr. Ludovic McLellan Mann and Capt. Robert Bush Black, the proprietor of the land. The circle, it is reported in *The Times* of September 15, has a radius of 86 ft., the ground plan being revealed by the socket-holes which held the wooden posts and showing a symmetrical arrangement, "involving circles, ellipses and a large number of serpentine figures". A cemetery adjoins the circle containing fifty-three burials, both cremated and inhumed, with grave furniture and stone settings, many of which are said to be of an unusual nature. The associated funerary vessels fall into four classes and indicate both stone and bronze age datings. For the further exploration of the site financial assistance is required. Should this be adequate the site will be preserved and the monument reconstructed. Donations should be addressed to Mr. J. Eric Fergusson, 166 Buchanan Street, Glasgow.

Educational Films

FROM the British Film Institute we have received three lists, intended for the use of teachers, of about a thousand 16 mm. films: "Geography Teaching and Travel" (about 600), "Science" (400) and "History" (30). Against the title of each is shown its length, whether silent or sound, reference to report, if any, in the Institute's monthly film bulletin, and name and address of distributor. A large majority of the films are silent. Among the sound films are thirty "road-shows" obtainable through Sound-Services, Ltd., which provides a complete projection service in combination with the hire of films. The other sources of supply are very various: camera makers (Kodak, etc.), trade publicity organizations (Australian and Canadian), railway and other travel agencies (L.M.S., Scottish, German, Dutch), firms specializing in educational films such as British Instructional Films, Ltd., Educational Films Bureau, Educational and General Services, Ltd., Gaumont-British Equipment, Ltd., Visual Education, Ltd., and Dance-Kaufmann Technical Films; also the Empire Film Library, G.P.O. Film Library and the National Film Library of the British Film Institute. Of the science films more than half are classified as zoology; others as physics and meteorology (72), botany (40), mathematics, astronomy, chemistry, geology, physiology and applied science. The prices, exclusive of postage, are: geography, 6*d.*; science, 4*d.*; history, nil. The Institute also issues lists of films dealing with agriculture and industry and catalogues of British medical films. The lists should prove useful to teachers, especially those who do not have access to the National Encyclopaedia of Educational Films. The Institute co-operated with the Educational Handwork Association in organizing a Film School, held in the University of London Institute of Education on July 26–August 6, at which there were lectures on the use of the film in school, film making for teachers, technique and manipulation, etc.

The Carnegie United Kingdom Trust

THE Carnegie United Kingdom Trust's annual reports are always worth reading, not only for the intrinsic interest of the Trust's achievements but also as revealing the latest developments of the administrative policies gradually evolved by the trustees. Co-operation with other trusts and relation to Government services are two aspects of the Trust administration that tend to call increasingly for careful study, owing to recent creations of other and comparable trusts and the ever-increasing liberality of the statutory services, notably since the inauguration of the Government's national health and youth programme. In this connexion, the report for 1936 notes that the Trust's playing fields policy, which has been completely successful, has now been discontinued, the future fulfilment of its objects having been sufficiently secured. Of the various land-settlement schemes which the Trust has been helping to finance, very encouraging accounts are given. "One of the most striking features of the new full-time holdings is the brightness of spirits of the whole community", although most of the men (about 110) had been unemployed for several years. Part-time subsistence holdings (about 1,000 in all) have been an immediate success in nearly every district where they have been established. Of the village halls the Trust has helped to finance, the report says their existence "has given new life to the community. Other recipients of the Trust's help during the year were: young farmers' clubs, the National Council of Social Service, new estates' community centres, amateur music societies, conductors' schools, adult education (inquiry into social and educational needs of the 18 + age-group), museums and libraries.

University or Polytechnic

IN the current issue of *Queen's Quarterly*, a Canadian review, "The Higher Learning" is discussed by Dr. R. C. Wallace, formerly president of the University of Alberta and now principal of Queen's University, Ontario. He refers to a recent assessment by R. M. Hutchins, president of the University of Chicago, of "The Higher Learning in America" (Yale University Press) which confirms Abraham Flexner's estimate of the modern university. Admitting that there is a tendency for the university to become a mere congeries of professional schools deserving rather the name of polytechnic, Dr. Wallace rejects the suggested remedy—the severance of professional schools from the university and the restriction of the university's field to the fundamental sciences and mental discipline, such as metaphysics. He argues that the aim of liberalizing university education may be realized by invigorating and revitalizing the arts school, establishing a system of organic connexions and interchange of thought between it and other parts of the university so that its influence may permeate them all, and selecting for key positions in the professional schools persons of wide sympathies and philosophic outlook capable of using professional courses as instruments of mental culture as well as of vocational training. So confident is he of the potential liberalizing influence of the arts school that he declares its actual impotence to be the gravest fault of the existing university system.

Economic Position and Outlook in Germany

AN admirable review of the economic outlook of Germany, contributed by Alwyn Parker to *Lloyds Bank, Ltd., Monthly Review* of July, deserves attention not only for its sympathetic but dispassionate analysis of the present economic situation in Germany but also for its discerning attempt to understand and interpret the motives and aims of the German system. It is pointed out that the serious cleavage of outlook between the Anglo-Saxon and the German owing to the clash of strong and irreconciliable historical traditions need not be incompatible with broad and real community of aim, sentiment and policy abroad. The author traces the factors which have rendered Germany a peculiarly receptive and fertile soil for the idea of self-sufficiency. Scientific workers will be interested in his critical review of the development of synthetic processes in Germany, notably his assessment of the petrol and synthetic rubber position, as well as in his discussion of the raw materials situation. In regard to rubber, he ventures the opinion that the large-scale substitution of a costly State-subsidized synthetic product for a cheap imported material must cause some abrasion of Germany's capital resources. The greatest interest of this survey lies not in its technical details but in its attempt to understand the German mind, its plea for fair-mindedness and its attempt to forecast the lines of understanding. The author indicates certain steps that the German Government could well take of itself, but while he obviously is unimpressed with Germany's legal or economic case for the return of her colonies, he emphasizes the value of some moderate colonial settlement and the opportunity for the best qualities of philosophic statesmanship and vision. This plea for impartial investigation and goodwill should not be overlooked by any who are concerned with re-establishing an international order in which Anglo-German friendship must find its place.

American Museum Meteorite Collections

DR. CHESTER A. REEDS gives in *Bull. Amer. Mus. Nat. Hist.* (1937) a detailed catalogue of the meteorites contained in this collection, which in 1935 was transferred from the Department of Geology to that of Astronomy, and is now housed in the new planetarium building. The previous catalogue, by Dr. E. O. Hovey in 1896, showed 45 specimens representing twenty-six falls. The collection now contains 3,744 specimens, representing 546 of the 1,073 falls known to the end of the year 1935. The large number of specimens is partly accounted for by 2,129 stones, ranging in weight from 0·2 to 6,650 grams, from the Holbrook, Arizona, shower of 1912. Notable masses are the three Cape York, Greenland, siderites, the largest of which weighs 36½ tons, that is, short tons of 2,000 lb., and is by far the largest meteorite preserved in a museum; and the Willemette, Oregon, siderite of 14·2 metric tons. Much of the general information in the catalogue, even that relating to American meteorites, is reproduced word for word from the late Dr. G. T. Prior's British Museum catalogue.

Mining Industry of Canada

THE Department of Mines of the Dominion of Canada has issued as usual its report for the Fiscal Year ending March 31, 1936 (Ottawa: King's Printer, 1936. 25 cents). This is a valuable paper and deserves careful study, especially the opening pages signed by Charles Camsell, Deputy Minister of Mines, which give a brief review of the whole mining industry of Canada; of course, the record of the gold industry is exceptionally important owing to the increased price of gold, but the base metals, copper, lead and zinc, also improved and played an important part in the increased value of the exports of base metals. This opening chapter is followed by fuller accounts of the various divisions included under mines, such as mineral resources, ore dressing and metallurgical, fuels and fuel testing, etc.

Centenary of Van der Waals

IN commemoration of the birth of J. D. v. d. Waals on November 23, 1837, an international conference on interaction between molecules will be organized by the "van der Waals Fonds" and the "Nederlandsche Natuurkundige Vereeniging". The ordinary sessions will be held in the van der Waals Laboratorium at Amsterdam on November 25 and 26, and an official celebration will take place on November 27. The object of the conference is to give a survey of some of the recent work connected with the idea of van der Waals forces. The programme will be published later. Sufficient time will be left for general discussion. A special number of *Physica* will appear during the conference; it is hoped to be able to publish in this issue a number of papers on a variety of questions having some relation to the work of van der Waals. Physicists willing to contribute to it should send in their manuscripts before October 15, and though it will be impossible to read all these papers during the conference, it is hoped that they will play an important part in the discussions. The organizing committee, comprising Prof. J. D. v. d. Waals, Dr. A. Michels, Prof. Dr. J. A. Prins and Dr. H. B. G. Casimir, van der Waals Laboratorium, Nieuwe Achtergracht 129, Amsterdam (C), will be glad to give further information.

Solvay Conference

THE Institut International de Chimie Solvay has issued personal invitations to its sixth chemical conference, which is to take place in Brussels on October 4–9, the chosen subjects for discussion being vitamins and hormones. Eight main papers have been promised, namely: P. Karrer, a general report on vitamins; H. von Euler, carotenoid and B_2 vitamins; Ad. Windaus, vitamins D and B_1; W. N. Haworth, ascorbic acid; A. Szent-Györgyi, physiological and therapeutic properties of the vitamins; L. Ruzicka, a general report on hormones; E. Laqueur, sex hormones; T. Kögl, vegetable hormones. Including those named, some twenty-five of the leading workers in these subjects have accepted invitations, so that very valuable discussions should take place during the eight sessions.

Announcements

THE Harben Lectures for 1937 will be delivered in the Lecture Hall of the Institute of Hygiene, London, on October 11, 12 and 13 at 4.30 p.m. by Prof. E. C. Dodds, Courtauld professor of biochemistry in the University of London, on "The Theoretical and Practical Significance of Endocrinology".

THE third National Coal Convention will be held at Harrogate on October 6–7, when the speakers will include Lord Horder and Sir Frederick Sykes, chairman of the Miners' Welfare Committee.

THE Lilienthal Society of Aviation, founded in 1936, will hold its annual congress at Munich on October 12–14, when there will be an exhibition relating to aviation. Further information can be obtained from the general secretary of the Society, Wilhelmstrasse 148, Berlin, S.W.68.

THE ninth International Congress on Psychotherapy will be held in Copenhagen on October 2–4. Prof. C. G. Jung of Zurich and Dr. Paul Bjerre will give the inaugural addresses. The chief subjects for discussion will be psychotherapy in general practice and "Can Psychotherapy be Taught?" Further information can be obtained from the general secretary, Dr. Olaf Brüel, 2 Amagertorf, Copenhagen K.

A SESSIONAL meeting of the Royal Sanitary Institute will be held on October 1 in the Town Hall, Llandudno, when Dr. D. A. Powell, principal medical officer of the King Edward VII Welsh National Memorial Association, will open a discussion on "Tuberculosis in Wales—a Stock taking", and Dr. R. W. Dodgson, director of the Ministry of Agriculture and Fisheries Shellfish Services, will speak on the Conway mussel purification tanks. On October 2 a visit will be paid to the Conway Station for a demonstration and inspection of the tanks. Further information can be obtained from the Secretary, Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 550.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays

IT is the purpose of this note to point out how rapidly and efficiently ternary equilibrium diagrams may be elucidated by means of X-ray analysis. In a recent paper, Jette[1] described a partial analysis of the chromium-iron-silicon system by X-rays. We have carried out the analysis of several ternary diagrams which will be published shortly. As an example, we give the diagram for the copper-nickel-aluminium system, the compositions being represented in the usual way by points within an equilateral triangle. Any one such diagram shows the phases at a given temperature, and a series of such diagrams is required to represent the state of affairs at different temperatures. The present diagram actually shows the phases present after a uniform heat treatment of slow cooling at 10° C. per hour. No claim is made that equilibrium has been established, our main object being to show the exploratory power of X-ray analysis. It will be supposed that the binary equilibrium diagrams, represented by the three sides of the triangle, have previously been established by metallurgical or X-ray methods. It is our experience that the investigation of the whole interior of the ternary diagram is, in general, easier than that of a single complicated binary system, since for the most part the phases are the same as those of the binaries. In other words, the appearance of quite a new phase is comparatively rare; we merely have to determine how far the two-component phases extend into areas of the ternary diagram.

The power and rapidity of the X-ray methods are due to the large amount of information which can be obtained from each powder-photograph of an alloy. The extent of this information makes it possible to explore the whole area by making up a relatively small number of alloys, judiciously chosen so as to fix the important feature of the boundaries. An X-ray photograph tells us:

(*a*) The number of phases present, which may be one, two, or three in a ternary diagram.

(*b*) The type of each phase, that is, face-centred cubic, body-centred cubic, 'γ' structure, etc.

(*c*) The lattice spacing of each phase, which in most cases makes it possible to deduce the compositions of the separate phases in a two-phase or three-phase area.

(*d*) The relative amounts of the phases present, deduced from the relative intensities of their lines in the photograph. In addition, the presence of superlattice lines can be detected.

The ternary diagram CuNiAl is shown in Fig. 1. It is divided into single-phase, two-phase and three-phase areas. The single-phase areas have curved boundaries. The two-phase areas are covered by 'tie lines' (not shown in the diagram though their general direction can be guessed from the straight-line boundaries of the areas). An alloy of composition represented by a point in a two-phase area breaks up into two phases of compositions represented by the ends of the tie-line running through the point from one single phase area to another. The three-phase areas are triangles, the vertices of which are at cusps on single-phase areas. An alloy anywhere within a three-phase area breaks up into three phases of the compositions represented by the vertices. The diagram exemplifies these points.

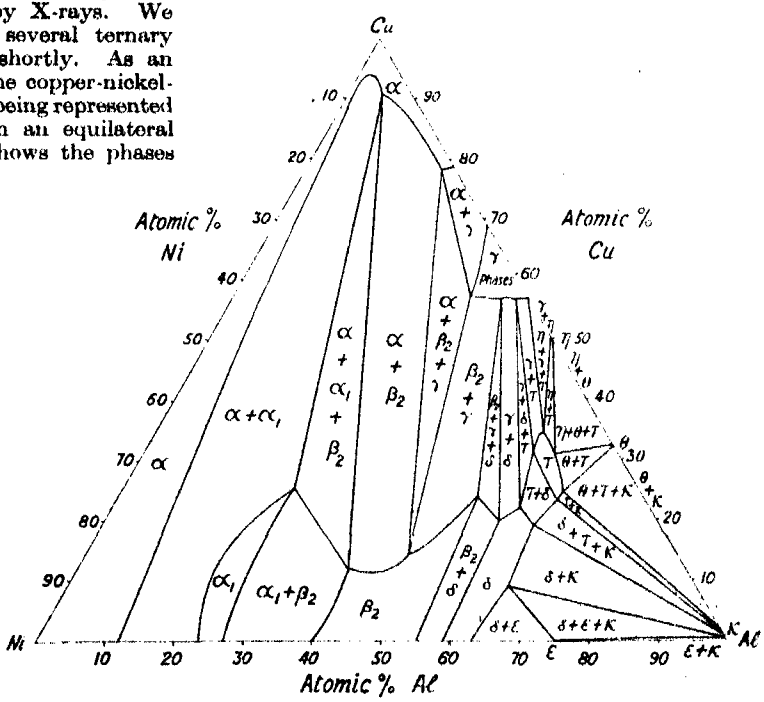

FIG. 1

Nomenclature presents some difficulties[2]. We have tentatively called all face-centred cubic phases 'α', body-centred 'β' and γ-type 'γ'. Superlattices are denoted by suffixes, for example, α_1, β_1. Phases only appearing with three components are denoted by Greek letters from the end of the alphabet, for example, τ, which checks with the phase found by

Bingham and Haughton[3]. The γ phases in the CuAl system are of several types, which cannot be shown separately on the present diagram.

We have made such investigations of the FeNiAl, CuNiAl and CuFeAl systems, and are investigating the FeCuNi system. These form ternaries from the four faces of a *quaternary tetrahedron*, and it is already possible to see the general nature of the equilibrium diagram for the quaternary system FeNiAlCu. There are indications of very interesting general features of these diagrams, in particular the effects of electron-atom ratio[4].

We are indebted to Prof. W. L. Bragg for his kind interest in this work.

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H. J. GOLDSCHMIDT.
H. LIPSON.
A. TAYLOR.

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July 31.

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[1] Andersen, A. G. H., and Jette, Eric R., *Trans. Amer. Soc. Metals*, **24** (2), 375–419 (1936).

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New Observations on Responses to Colours in Egg-laying Butterflies

It has previously been shown[1] that hungry cabbage butterflies give a specific response, "spontaneous feeding response", on red, yellow, blue and violet papers, but not on green, bluish green or grey of any shade between black and white. Whether the insects confused green and bluish green with grey could not be investigated as they could not be trained on these colours.

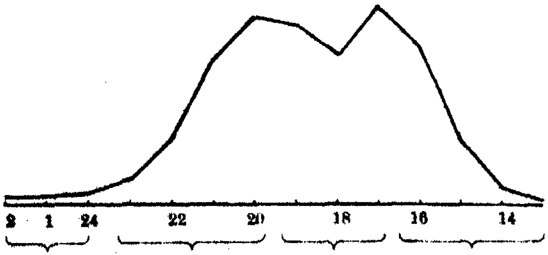

Fig. 1.

I have now found another specific response to colours which makes it possible to investigate this point. As in several other species of butterflies[2] the female cabbage white, *Pieris brassicæ* L., during egg laying will fly to leaves of various plants and on their surface perform what I have called a "drumming reaction". This reaction consists in a very quick alternating movement of the first pair of legs. It can be elicited by any object which shows certain colours. As it cannot be confused with the feeding response, it has been used as a basis for a new series of experiments on colour vision.

In every experiment, fifteen small models, cut out of grey papers of several different shades, and of coloured papers belonging to the twenty-four Standard Ostwald papers, were offered simultaneously. All the grey papers were entirely neglected. The results for the coloured papers are shown in two curves (Figs. 1 and 2). In Fig. 1, the colours from yellow to blue, according to their position in the spectrum, are plotted against the relative number of drumming reactions on each colour.

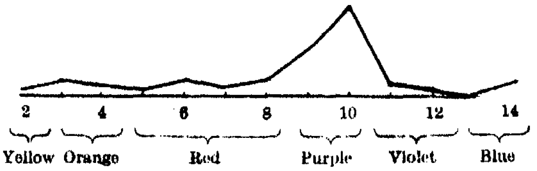

Fig. 2.

It can be seen that the butterflies in the stage of egg laying very distinctly select a continuous range from "Emerald Green" (Ostwald No. 22) to "Oxide Blue" (Ostwald No. 16) which is slightly greenish; whereas yellow and pure blue are practically neglected. This shows that they were able to distinguish this range of colours—the greater part of which had been neglected by the same insect when seeking food —from grey as well as from yellow and pure blue. The definite distinction between yellow and green was surprising, because these two colours are confused by most insects, especially the hive bee[3]. Thus the humming bird hawkmoth, which during egg laying is attracted by green, visits yellow as well, but neglects bluish green[4]. Exactly those bluish green papers which by most insects are constantly neglected, or even confused with grey[5], proved to be most attractive to the female cabbage white. This is a new proof that the system of colour vision in *Pieris* must be entirely different from that in the hive bee and most other insects, and nearer to that of man.

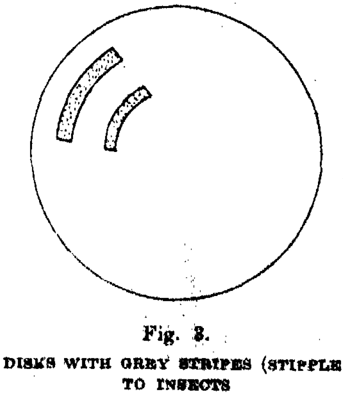

Fig. 3.
COLOURED DISKS WITH GREY STRIPES (STIPPLED) OFFERED TO INSECTS

Another observation also supports this suggestion. Fig. 2 shows the relative number of drumming reactions on the Ostwald papers beyond yellow and blue. It was surprising to find among these colours a distinct though comparatively small peak in purple (Nos. 9 and 10). A more careful observation of the drumming on purple, however, showed that about half the reactions were performed on the adjacent background, which never happened when the insects drummed on green or bluish green. This raised the suggestion that for the eyes of the cabbage white, as for those of man, the purple colours might induce a greenish colour in their surroundings by a simultaneous colour contrast. (For the eyes of the hive bee, purple seems to induce a yellowish colour[6].)

To decide this question, in a second series of experiments much bigger models were used, which made it easier to see the exact place of the drumming. Moreover, these models had been furnished with a few small colourless stripes (see Fig. 3) which for our eyes showed an especially strong contrasting colour. In an experiment where two green disks (No. 22 and 21) and two purple disks (No. 9 and 10), each of six inches diameter, were offered simultaneously, the result was as follows :

	Number of drumming reactions on :			
	Coloured disk	Adjacent background	Colourless stripes	Total
Green	48	2	0	50
Purple	0	6	9	15

This provides very suggestive, if not conclusive evidence, that, for the eye of the cabbage white, on the colourless areas adjacent to purple, one of the greenish colours which elicits a distinct drumming reaction had been induced by a simultaneous colour contrast.

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Photo-labile Pigments of the Chicken Retina

THOUGH visual purples of the retinal rods have been known for sixty years[1,2], nothing has been learned directly of analogous substances in the cones. In the chicken retina, which contains principally cones, attempts to identify photo-labile pigments heretofore have failed[3]. I have extracted from it two such pigments.

Retinas of ten 8-week old dark-adapted chickens, prepared in very dim red light, are ground immediately in 4 c.c. of 3 per cent sodium chloride and 2 per cent digitonin in water. This mixture is centrifuged after about eight hours in the dark at room temperature. Spectra of a 1 cm. layer of the extract are recorded photo-electrically.

The extract is light orange in colour and possesses a complicated spectrum. On irradiation with deep red light (above 650 mμ), its extinction falls between about 470 and 700 mμ, maximally at about 575 mμ, and rises below about 460 mμ. Sufficiently long irradiation completes these changes. The final difference in extinction between the unbleached and bleached preparations ('difference spectrum') is shown in Fig. 1 *A*. I believe it to represent the photo-labile pigment of the cones.

When red light produces no further effect, the residue is exposed to bright white light. The extinction now falls between about 435 and 620 mμ, maximally at about 508 mμ, and rises below about 480 mμ. The difference spectrum of this change is shown in Fig. 1 *B*. It is characteristic of rhodopsin[3,4].

If retinas are soaked in 4 per cent alum for several hours following dissection, their digitonin extracts yield the difference spectrum of rhodopsin alone. The alum treatment apparently renders the cone pigment insoluble. An extract of chicken retinas with 2 per cent disodium phosphate, freezing and thawing several times during extraction, displayed no measurable trace of either pigment.

The rise in absorption below 460 mμ on irradiation shows the cone pigment, like rhodopsin[4] and porphyropsin—the visual purple of certain freshwater fishes[5]—to bleach to coloured products. Its difference spectrum, therefore, may partly resemble, but obviously is not, its true absorption spectrum.

Rhodopsin, porphyropsin and the cone photopigment form a graded series, in which functions and properties run closely parallel. Their colours are respectively red, purple and apparently violet. I propose to call the cone pigment *iodopsin* (ἴον = violet).

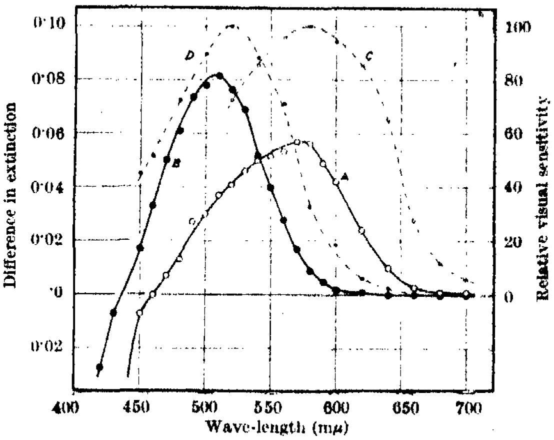

Fig. 1.

CHANGES IN EXTINCTION OF CHICKEN RETINAL EXTRACT DUE TO (*A*) IRRADIATION WITH RED LIGHT, AND (*B*) SUBSEQUENT IRRADIATION WITH WHITE LIGHT. BROKEN LINES SHOW HONIGMANN'S MEASUREMENTS OF SPECTRAL SENSITIVITY OF (*C*) LIGHT-ADAPTED, AND (*D*) DARK-ADAPTED CHICKENS.

The positive portion of the difference spectrum of rhodopsin resembles the sensitivity of the rods to light of various wave-lengths[6] (sensitivity here is the reciprocal of the minimum energy needed to evoke a constant response). A similar relation has been inferred to exist between known spectral sensitivities of cones and the spectra of hypothetical cone photopigments[6,8]. Honigmann[7] has measured the spectral sensitivity of light- and dark-adapted chickens. His data, plotted as percentages of their maxima, are shown in Fig. 1 *C* (light adapted—cone function) and Fig. 1 *D* (dark adapted—rod function). Light adaptation shifts the maximal sensitivity from about 520 to about 580 mμ. This is the familiar Purkinje effect, for which clearly the extracted photo-pigments form an adequate chemical basis.

The difference spectra of rhodopsin and porphyropsin are nearly symmetrical in form[3], while that of iodopsin is decidedly skew, due to stronger absorption on the short wave-length side of its maximum. In this spectral region the visual sensitivity might be expected to be correspondingly high. However, this is also the region in which the effectiveness of light entering the chicken cones is decreased through absorption by carotenoid filters[8]. The net result is the nearly symmetrical sensitivity function shown in Fig. 1 *C*.

Trichromatic vision in man may depend upon the presence in the cones of three distinct photo-labile pigments, differing in absorption characteristics[9]. In the chicken retina three groups of colour filters provide a possible basis for hue differentiation. It is unnecessary, therefore, to assume more than a single cone photo-pigment in this animal.

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Aug. 19.

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Hæmodynamic Factors in the Uterus during the Latter Part of Gestation

ACCORDING to the data of Barcroft, Herkel and Hill[1], a critical change takes place in the rate of blood flow through the uterus of the rabbit after the twenty-second day of pregnancy. The rate of flow diminishes approximately one third between this and the twenty-fifth day, although it increases again by the twenty-seventh day of gestation. In an earlier paper by Barcroft and Rothschild[2], measurements were made of the volume of blood contained within the maternal vessels of the uterus on different days of pregnancy. The data of this study show that the volume of blood increases to a maximum by the twenty-eighth day and diminishes by fifty per cent during the next two days. The volume of the placental tissues during this time follows a parallel curve, so leading these investigators to the reasonable conclusion that the volume of blood in the uterus increases as the extent of the placental vascular bed increases. The cause of the changes in the rate of blood flow through these vessels has not, however, been described. When the foregoing data were used to estimate the *efficiency* of the uterine circulation during the latter part of gestation as certain growth changes take place, an insight was gained into some of the hæmodynamic factors operating at this time, providing a basis for interpreting the effects which Barcroft and his associates have reported.

The percentage of the blood volume which changes each minute (that is, the efficiency of the maternal circulation in the uterus) has been calculated from the data cited above with the result shown in the accompanying table:

Day of pregnancy	Blood volume of uterus	Minute-volume of blood	Efficiency (% turn-over)
14	8·0 c.c.	5·0 c.c./min.	62·5
18	12·3 ,,	13·5 ,,	109·7
20	14·5 ,,	20·0 ,,	137·1
22	16·2 ,,	29·0 ,,	179·0
25	21·5 ,,	19·0 ,,	88·3
27	29·0 ,,	27·5 ,,	94·8
28	32·0 ,,	28·5 ,,	89·0

Here, it will be seen, a marked increase takes place in the turn-over of the blood each minute until the twenty-second day, as the blood volume increases coincidently. By the twenty-fifth day a marked decrease occurs in the efficiency of the local circulation. This fall parallels that which takes place in the circulation rate. From this point on, so far as the data go, this level of efficiency in the uterine circulation is maintained. The level at this time equals that found on the seventeenth day of pregnancy when the embryos are almost inappreciable in size, whereas by the twenty-fifth day they are comparatively large and are growing at a nearly maximum rate[1]. The oxygen requirement of the embryos is met by greater oxygen unsaturation of the blood as it flows through the uterus[1].

The significance of these considerations is shown by the recent discovery that a critical change occurs in the relationship between the rate of growth of the uterus and the growth of the products of conception about the twenty-second day of gestation. Between the twenty-second and the twenty-fourth days the uterus commences to grow less rapidly, from causes already described[3,4]. At the same time, the products of conception grow at a rate almost as rapid as at any time during pregnancy[3,4]. The fœtuses and their associated structures must act, therefore, as an impeding influence to the maternal circulation and so serve as a factor which diminishes the quantity of blood flowing through the maternal vessels of the uterus at this time. This resistance to the local flow of blood in the maternal circulation of the uterus is transient, however, as shown by the data of Barcroft, Herkel and Hill.

It is therefore clear that the rate and efficiency of the blood flow in the maternal circulation of the uterus are adversely affected as the influence of distention first becomes manifest, but with increasing degrees of distention as pregnancy nears term, some compensating adjustment takes place which maintains the efficiency of this local circulation of blood. The pumping action of the increasing muscular movements which are known to take place at this time[5] would serve such a purpose. The efficiency and forcefulness of these contractions would likewise be enhanced by the increasing distention resulting from the disproportion in the rates of uterine and fœtal growth respectively.

These considerations suggest, therefore, that the increasing distention which the uterus undergoes in the latter part of gestation first brings about a diminution in the efficiency of the maternal circulation through the uterus. As the degree of distention becomes greater, however, it becomes *pari passu* the means by which the efficiency of this circulation is maintained, mainly by virtue of the influence which distention has upon the contractility of the myometrium.

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Devernalization of Spring Rye by Anærobic Conditions and Revernalization by Low Temperature

A PREVIOUS letter in NATURE[1] presented evidence to show that in winter rye (var. Petkus) anærobic conditions at normal temperatures (20° C.) when alternated with ærobic conditions at 1° C. quantitatively annul the vernalizing effect of low temperature. It appeared possible, therefore, that spring rye of the same variety might be devernalized by the application of anærobic treatment at 20° C. Previous work[2,3] has shown that the process of vernalization in winter rye decreases the number of leaves produced on the main axis before flower initiation, as well as decreasing the period of time required to reach anthesis. An increase in these characteristics in spring rye after anærobic treatment would thus indicate a process of devernalization.

The experiment was performed by sealing the grains in tubes, with sufficient water to imbibe them fully, in an atmosphere of pure nitrogen, leaving for varying periods at 20° C., and then sowing in sand culture. Periods up to three weeks alone could be used, as longer exposures to anærobic conditions led to death of the seeds.

The results of this experiment are given in Table 1.

Table 1.

DEVERNALIZATION OF SPRING RYE BY ANÆROBIC TREATMENT.

Preliminary period in nitrogen	No. of leaves on main axis	Days to anthesis	No. of replicates
Control (none)	6·80 ± 0·20	50·3 ± 0·49	10
1 week	7·52 ± 0·11	52·6 ± 0·45	23
2 weeks	7·67 ± 0·13	54·4 ± 0·73	24
3 weeks	8·29 ± 0·36	57·4 ± 1·7	7

A significant increase in leaf number and time to anthesis follows anærobic treatment, thus establishing the possibility of devernalization at normal temperature.

The process of vernalization is held by us to be a specific effect of low temperature, and in confirmation of this view it has been established that spring rye partially devernalized by anærobic conditions may again be vernalized by subsequent exposure in air to 1° C. The data are given in Table 2.

Table 2.

REVERNALISATION OF SPRING RYE AFTER ANÆROBIC TREATMENT
All variants, except controls, received 3 weeks' chilling at 1° C. in air after removal from anærobic conditions.

Preliminary anærobic treatment	No. of leaves on main axis	Days to anthesis	No. of replicates
Control (none)	6·80 ± 0·20	50·3 ± 0·49	10
1 week	—	47·3 ± 0·34	14
2 weeks	7·10 ± 0·23	50·5 ± 0·79	10
3 weeks	All plants failed		

It will be noted that both leaf number and time to anthesis have been reduced to the level of the controls which were untreated.

These results thus add further evidence for the reversible nature of the vernalization process.

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Artificially Prepared Visible Paracrystalline Fibres of Tobacco Mosaic Virus Nucleoprotein

A RECENT letter in these columns[1] contained photomicrographs of mesomorphic or paracrystalline fibres of tobacco mosaic virus which had formed spontaneously in clarified juice expressed from diseased tobacco leaves. Similar fibres have now been prepared from solutions of the pure virus protein by suitably adjusting the *p*H value of the medium and the salt and virus concentrations. Although the fibres may be produced over a relatively wide range of *p*H values, the best results are obtained at a *p*H value of about 5 (near to the point where, in the comparative absence of salts, virus solutions are most viscous or gel-like).

The pure virus was obtained by a combination of precipitation with 15 per cent ammonium sulphate solution at *p*H 7 with isolectric precipitation from acetate buffers at *p*H 3·4 as previously described[2]. A suitable salt concentration is provided by 0·4 *M* ammonium sulphate. The fibres formed under these conditions have the same dimensions and properties as the fibres previously described[1], except that they are frequently more easily broken up.

Spontaneously formed fibres, when separated and dissolved in water, give a solution containing no visible (× 1000) particles, but by adjusting the *p*H value and salt concentration the long flexible paracrystalline fibres are re-formed. Samples of pure virus protein prepared from spontaneously formed fibres, from artificially formed fibres or prepared in the ordinary way, contain (on a dry weight basis) the same percentage nitrogen (16·6) and phosphorus (0·5), and when diluted to one part by weight in a million give comparable numbers of primary lesions on *Nicotiana glutinosa* leaves.

The temperature at which artificially formed fibres disrupt is the same as for the spontaneously formed ones. Taken in conjunction with the evidence presented in the previous letter[1], there can be no doubt of the identity of the fibres with the virus.

Bernal and Fankuchen[3], by means of X-ray analysis, deduced the arrangement of the virus molecules within the paracrystalline aggregates. They point out that in view of this structure, homogeneity of the aggregates is less certain. I assume that by this they mean that viruses like yellow tobacco mosaic, a closely related mutant strain of ordinary mosaic virus, may form a part of such aggregates without altering the general arrangement. This is a possibility which cannot be overlooked. However, my preparations were derived from plants which had been artificially infected with virus separated at its iso-electric point of *p*H 3·4, and which had been raised in an isolated compartment of an insect-proof glasshouse and showed no symptoms other than those of ordinary mosaic.

The finding of Bawden and Pirie[4] that the virus contains nucleic acid has been confirmed, and my preparations contain 0·52 per cent phosphorus. There is evidence to associate the acid prosthetic groups deduced by me[5] on the basis of the *p*H activity curve for this virus, with the nucleic acid demonstrated by Bawden and Pirie. The circumstance that Stanley's[6] earlier preparations contained no demonstrable amounts of phosphorus, and the presence of small but variable amounts in his later preparations[7] are understandable when it is realized that during the purification processes his preparations were exposed to *p*H values which are known to inactivate a large percentage of the virus, and that this action must have been more pronounced in his earlier methods. The test for active virus is much more sensitive than the test for phosphorus.

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[1] Best, Rupert J., NATURE, **139**, 628 (1937).

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Blood-groups of Veddahs

BLOOD-GROUPING in the field in Ceylon presents almost insurmountable difficulties, so that no records of blood-grouping of the Veddahs have been hitherto published. Until recently I had only one record—that of a Veddah whom I had persuaded to come down to Colombo for treatment in hospital. Recently, however, I had the opportunity of making observations on a series of four more Veddahs. These were brought to Colombo, with two others, who refused to give blood, by an enterprising showman, for exhibition at a fair held on the occasion of the Coronation celebrations. All the Veddahs were tolerably good specimens of their race. The blood samples were examined independently by myself and by the staff of the Pathology Department, General Hospital, Colombo, with identical results. I used imported standard sera (Burroughs and Wellcome's) that had been kept in the refrigerator. The hospital authorities make their own standard sera. Although the numbers examined are too few for any definite conclusions to be drawn, I consider they are worthy of record in so far as no previous information is available relative to this important race.

TABLE I. BLOOD-GROUPS OF VEDDAHS.

Veddah No.	Name	Sex	Locality	Blood-group
1.	Davitha	♂	Bulugahadena Bintenne	*B*
2.	Kaira	♂	Dambane Bintenne	*O*
3.	Burunda	♂		*B*
4.	Kanda	♂		*O*
5.	Dematha (son of No. 4)	♂		*O*

These results give a proportion of 60 per cent Veddahs with the *O* group and 40 per cent with the *B* group. The proportion of *O* is thus practically the same as in the Australian aboriginal, but the *B* group differs considerably in the two races. On the contrary, the Paniyans of South India agree with the Australians in the low proportion of *B*, but differ from both Australians and Veddahs in the low proportion of *O*. The difference is made up by a high proportion of group *A* (see Aiyappan, 1936[1]).

With regard to the other inhabitants of Ceylon, I give below the results of a series of blood-groupings which have been taken in the General Hospital, Colombo, for routine blood-transfusion purposes, and for which I am indebted to Dr. S. Thiagarajah, the pathologist to that institution. It will be noted that, in all the communities studied, group *O* takes the highest place, except in the Moors, where groups *O* and *B* are in equal proportion. Group *B* is also high in the Tamils, so that the high value of that group in the Moors is to be explained by the amount of Tamil blood present—a fact which is corroborated by their physical characters. The Sinhalese, on the contrary, have an almost equal proportion of individuals with groups *A* and *B* blood. The Veddahs, therefore, so far as the meagre numbers examined throw any light upon the question, do not resemble either of the predominant local populations, but fall into a category of their own. Examination of larger numbers would most probably bring them into line with the Australian aboriginals, a supposition which would be expected on the grounds of their physical characteristics.

TABLE II. BLOOD-GROUPINGS OF OTHER CEYLONESE PEOPLES.

People	Numbers examined	Group *O*	Group *A*	Group *B*	Group *AB*
Sinhalese	712	335	187	176	14
Tamils	136	69	19	42	6
Burghers	61	35	17	8	1
Moors	29	10	7	10	2

TABLE III. PERCENTAGE REPRESENTATION OF BLOOD-GROUPS IN THE PEOPLES DISCUSSED HEREIN.

People	Group *O*	Group *A*	Group *B*	Group *AB*
Veddahs	60	—	40	—
Paniyans	20	60	7	10
Australians ..	57	38·5	3	1·5
Sinhalese	47	24·7	23·1	2·0
Tamils	50·7	14	30·9	4·4
Burghers ..	57·4	27·7	13·1	1·6
Moors	34·4	24·1	34·4	6·8

In conclusion, I have to acknowledge my indebtedness to Prof. F. O'B. Ellison of the Physiology Department, Ceylon Medical College, and his laboratory staff for the use of apparatus in his department.

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[1] Aiyappan, A., *Man*, **36**, 255 (1936).

Modes in Modern Egyptian Music

WE have been engaged on determining the frequency ratios involved in the principal musical scales or modes in current use in Egypt to-day. These scales were the subject of a controversial discussion at an international congress held in Cairo in March 1932.[1]

In the present investigation, three expert tuners (appointed by the Royal Institute of Oriental Music) tuned a Qanun, an instrument consisting of strings stretched on a sounding board, to the different modes, and the frequencies were then measured by means of an audio-frequency valve oscillator to which a calibration curve was plotted by means of a set of standard tuning forks. The actual determination of each frequency was carried out using the method of beats. The notes constituting each scale were taken in ascending and then in descending order, so as to correct for possible variation in temperature. The experimental error is of the order of 0·1 per cent.

The results for each of the three tuners were recorded separately and an average was then taken. The following table gives the fourteen recognizable intervals into which an octave was found to be subdivided compared with the diatonic and equitempered scales.

The four principal modes correspond to the following groups of notes (quoted by their numbers): (1, 3, 5, 7, 9, 11, 13), (3, 4, 8, 9, 11, 13, 1′), (3, 5, 7, 8, 11, 12, 1′), (1, 3, 4, 7, 9, 10, 14). Of these the last is the same as the minor scale in European music.

No. and Name of Note	Frequency ratios		Equi-tempered scale	Diatonic scale	Symbol
	Our results	Conf'nce results			
1 Rast	1	1	1	1	C
	..	..	..	1·042	C♯
2 Shahnaz	1·057	..	1·057	..	
	..	..	..	1·080	D♭
3 Doka	1·123	1·123	1·120	1·125	D
	..	..	..	1·171	D♯
	..	..	1·187	..	
4 Kurd	1·200	..	..	1·200	E♭
5 Sika	1·228	1·227	..	..	E‡♭
	..	..	..	1·250	E
	..	..	1·257	..	
6 Nim Busalik	1·274	..	..	1·279	F♭
	..	..	..	1·302	E♯
7 Girka	1·330	1·337	1·330	1·333	F
	..	..	..	1·390	F♯
8 Higaz or Saba	1·417	..	1·411	..	
	..	..	..	1·440	G♭
9 Nawa	1·498	1·503	1·496	1·500	G
	..	..	..	1·562	G♯
10 Hisar	1·590	..	1·583	..	
	..	..	..	1·600	A♭
11 Huseini	1·685	1·685	1·677	1·667	A
	..	..	..	1·738	A♯
12 Agam	1·779	..	1·778	..	
	..	..	..	1·800	B♭
13 Irak	1·831	1·838	..	..	B‡♭
14 Nim Mahur	1·880	..	1·882	1·875	B
	..	..	..	1·920	C♭
	..	..	..	1·955	B♯
1′ gawab el Rast	2·000	2·000	2·000	2·000	C

Other modes are obtained by changing the first note (key-note) in a group. The most characteristic feature of the scheme is the appearance of neutral thirds and neutral sevenths.

A fuller account will appear elsewhere.

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[1] "Oriental Music Conference," p. 559 (Cairo, 1932).

Magnetic Anisotropy of Rare Earth Sulphates and the Asymmetry of their Crystalline Fields

IN an important paper in the *Physical Review* for 1932 Penney and Schlapp[1] have discussed theoretically the Stark-splitting of the energy levels of the rare earth ions in crystals under the influence of the crystalline electric fields, and its influence on the magnetic behaviour of the ions. Experimentally, Spedding and his co-workers[2] have studied the absorption spectra of rare earth salts of the type $M_2(SO_4)_3.8H_2O$, where M = Pr, Nd, Er at different temperatures, and thence deduced the low-lying energy levels of the M+++ ions in the crystals. They find that (1) the number of low-lying energy levels and their relative separations are the same as predicted by the theory for a field of cubic symmetry acting on the M+++ ions; (2) the intensity of the cubic field required to produce the observed separations is the same in all the three crystals, as should be expected from their isomorphism; (3) the observed separation of the levels is not inconsistent with the available magnetic data for the mean susceptibilities of the crystals. From these and other results, it has been concluded that the fields acting on the M+++ ions in these crystals should be almost rigorously cubic in symmetry.

One direct result of such a cubic symmetry in the field would be a magnetic isotropy for the crystal, and any observed deviation from isotropy will give us some idea of the deviation of the field from cubic symmetry. We have recently measured the principal magnetic susceptibilities of single crystals of several rare earth salts, and we give below the values for the anisotropy of the sulphates; $\Delta\chi$ denotes the difference between the maximum and the minimum principal susceptibilities of the crystal, and χ the mean of the three principal susceptibilities.

Crystal	$\Delta\chi/\chi$
$M_2(SO_4)_3.8H_2O$	
M = Pr	0·20
Nd	0·11
Sm	0·21
Er	0·12

$\Delta\chi/\chi$ is not small, and when we remember that the group of atoms associated with each M+++ ion in the crystal should have at least this anisotropy, and has very probably more (as the different groups present in the unit cell of the crystal—probably eight in number—will not, in general, be oriented parallel to one another) and that it is the anisotropy of the above group (and not that of the crystal) which corresponds to the asymmetry of the field under consideration, it is easy to realize that the deviation from cubic symmetry should be quite marked. From an inspection of the table it becomes clear, as pointed out by Penney and Kynch[3], that the non-cubic part of the field has produced separations in levels, degenerate in the cubic field, comparable in size with those of the cubic field pattern itself.

A rediscussion of the valuable results on the absorption spectra of these crystals obtained by Spedding and his co-workers, taking into account the non-cubic nature of the crystalline fields as evidenced by the magnetic anisotropy of the crystals, is very desirable.

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[1] *Phys. Rev.*, 41, 194 (1932).

[2] *J. Chem. Phys.*, 5, 191, 316, 416 (1937).

[3] NATURE, 140, 109 (1937).

Variations of Cosmic Ray Intensity during Magnetic Storms

IN a paper[1] on trajectories of electric particles with applications to cosmic rays, published January 4, 1937, I directed attention to possible effects of magnetic storms in the following words:

"As to other electromagnetic fields which may modify this supposition (regarding simplifying hypotheses for the mathematical treatment), the only case of interest may be *the outer magnetic field during magnetic storms*. It would be very interesting to make a careful inspection of the cosmic ray registrations during such a storm (for instance of the order of magnitude of the storm of February 4th, 1872, when auroras were seen almost over the whole earth) in order to discover possible actions due to this field."

It is most interesting that such an effect has just been observed during the recent magnetic storms in April this year, both by Mr. S. E. Forbush in America[2] and by Prof. Victor F. Hess and A. Demmelmair in Europe[3].

We have here an effect analogous to the effect of magnetic storms on auroras, driving the aurora zones away from their usual situations and towards the magnetic equator as the intensity of the storm increases.

The mathematical theory of the motion of electric particles in the earth's magnetic field, which I developed[4] so long ago as 1904, and which Mr. Forbush attributes to Lemaître and Vallarta, receives by these new facts renewed interest and suggests continual observations of cosmic rays both in high and low magnetic latitudes, because the solar activity and magnetic storms both approach their maximum intensity.

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[1] "On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Application to the Theory of Cosmic Radiation, Sixth Communication", *Astrophysica Norvegica*, [ii] 4, 195 (1937).

[2] *Phys. Rev.*, **51**, 1108 (1937).

[3] NATURE, **140**, 316 (1937).

[4] For details see Oslo University Observatory Publications No. 10, Oslo 1934, and *Phys. Rev.*, **45**, 835 (1934).

Points from Foregoing Letters

As an example of the ease with which equilibrium diagrams of alloys containing three elements can be obtained, by means of X-ray analysis, A. J. Bradley, H. J. Goldschmidt, H. Lipson and A. Taylor submit a diagram for the copper-nickel-aluminium system. It shows the phases present at different percentage composition, after a uniform heat treatment (slow cooling at 10° per hour; equilibrium not necessarily established). The X-ray method gives at the same time the number, nature and relative amount of phases present and the lattice space of each phase.

Dora Ilse describes experiments on the response of egg-laying butterflies to coloured papers; these indicate that colour vision in the cabbage butterfly, *Pieris*, is different from that in the hive bee and most other insects and nearer to that of man. The cabbage butterfly in the stage of egg-laying reacted to a range of colours from 'emerald green' to 'oxide blue' and responded also to simultaneous colour contrast (green induced on white background adjacent to purple).

Dr. G. Wald has extracted from chicken retinas rhodopsin and the photo-labile pigment of the cones, heretofore unknown. The shift in visual sensitivity toward the red on light adaptation (Purkinje effect) in the chicken appears to depend upon the spectral characteristics of these pigments. The cone pigment, for which the name iodopsin is proposed, is apparently violet in colour and bleaches to coloured products.

From the data of Barcroft and his associates, Dr. S. R. M. Reynolds has estimated the efficiency of the maternal circulation of the uterus of the rabbit between the fourteenth and twenty-eighth days of gestation. It is found that the minute-volume turnover of blood in the uterus increases until the twenty-second day, after which it decreases sharply. This decrease in the efficiency of the uterine circulation is coincident with a period of diminished uterine growth and accelerating fœtal growth. It is suggested that with the onset of increasing distention the uterine circulation is impeded, but as the influence of distention becomes more marked, the circulation through the uterus is aided, chiefly by the increasingly effective contractions of the myometrium which occur as gestation nears term.

Cold-treated ('vernalized') wheat grains, imbibed in water and kept in an atmosphere of nitrogen at 20° C., will survive, according to Prof. F. G. Gregory and O. N. Purvis, for three weeks, and will become devernalized, as shown by a significant increase in the leaf-number and in the time of flowering. Partially devernalized spring rye may again be vernalized by subsequent exposure in air to 1° C.

The artificial preparation, from pure virus protein, of paracrystalline fibres of tobacco mosaic virus is described by R. J. Best. The properties of these fibres are similar in all respects to the spontaneously formed ones previously described in NATURE. Bawden and Pirie's demonstration of the presence of nucleic acid in the virus molecule has been confirmed.

Blood examination of five Veddahs from Ceylon, reported by Prof. W. C. O. Hill, showed two of them to belong to the blood-group *B* and three to blood-group *O*. The author believes that examination of a larger number of individuals will probably show that they are similar to the Australian aborigines. He also gives tables showing the blood-groupings of peoples from the island and the percentage blood-groups in each. In all communities of Ceylon which have been studied, group *O* takes the highest place, except in the Moors, where group *O* and *B* are in equal proportion.

A table is given by M. Mokhtar and Dr. A. M. Mosharrafa showing fourteen recognizable intervals into which an octave, in modern Egyptian music, could be subdivided, compared with the diatonic and the equitempered scales. The notes were obtained by means of a Qanun, an instrument consisting of strings on a sounding board, and the frequencies were measured by means of an audio-frequency valve oscillator calibrated with a set of standard tuning forks.

From extensive studies on the absorption spectra of crystals of hydrated sulphates of the rare earths at different temperatures, Spedding and his co-workers have concluded that the crystalline electric fields acting on the rare earth ions in these crystals should have cubic symmetry. Prof. K. S. Krishnan and A. Mookherji now report marked magnetic anisotropy of these crystals, which does not support this conclusion.

Prof. C. Störmer quotes a statement which he published last January, indicating on theoretical grounds the possibility of an interrelation between magnetic storms and the intensity of cosmic rays, which has since been observed by Forbush in America and by Hess and Demmelmair in Europe.

Research Items

Problems of the New Stone Age

SOME problems in the changed outlook of the last twenty years on the introduction and spread of the neolithic civilization into Europe have been discussed by Mr. H. J. E. Peake (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, 1936–7). By 1925 it had been shown that the neolithic culture had reached Switzerland from western Asia by way of the Ægean and Danube Valley early in the third millennium B.C. The problem remained whether it reached the west in the same way or had come by sea from the eastern Mediterranean. This question must be viewed from the wider standpoint, in time and space, of when man first began to cultivate grain and domesticate animals, and how such knowledge reached our islands. Cultivation of wheat apparently began in south Syria or northern Palestine. Early grain growers are, with certain exceptions, always possessed of domesticated animals, and the precise origins of agriculture are obscure. Its progress, however, can be traced from Asia, through the Ægean to Switzerland, via the Danube. West of the Rhine, however, is a rude pottery, which has been filiated with the leather bag, derived, it is now suggested, from animal *scrota*. This 'bag-ware' is found widely distributed in western Europe, appearing in Switzerland and Germany from the west, and having as its starting point Lusitania. Important elements in this Lusitanian culture are shown to derive from the eastern Mediterranean—the tombs and the pottery. The megalithic tomb is traced back to Tell Arpachiya and thus related to the Tell Halaf culture of the fourth or fifth millennium, while it descends to the stone cist of the early Bronze Age. The evidence of the pottery depends on a number of decorative and other details traced from the eastern Mediterranean and ultimately Tell Halaf, beginning not later than the end of the fourth millennium, and appearing in the Iberian peninsula about 2800 B.C. Cattle, which could scarcely have been brought from the Ægean, were probably acquired by contact with Danubian peasants of Switzerland. This culture passing through France reaches Britain by a land bridge from Artois, and appears as the early neolithic culture of Windmill Hill. The red "bag ware" found at Maiden Castle, on the other hand, may have reached Britain from Brittany.

South African Native Cattle

LITTLE has been attempted by Europeans in the way of improving the cattle of Africa by selection within native breeds, the practice being to intergrade with European breeds. H. H. Curzon and R. W. Thornton, realizing the potentialities of the native cattle, have laid a foundation for further investigations by outlining the cattle types of Africa and their approximate distribution (*Onderstepoort J. Vet. Sci. Anim. Ind.*, 7, 613; 1936). Probably all the breeds, except the Hamitic longhorn of Egypt, came originally from Asia, and all reached their destination through north-east Africa except the shorthorned zebu which was introduced along the east coast north of the Zambezi River. Three parent stocks are involved—Hamitic longhorn, brachyceros and lateral-horned zebu; and from these three other types have been derived—short-horned zebu, sanga, and lyre-horned zebu. In West Africa there are possibly two other types derived from admixture of brachyceros and Hamitic longhorn in one case, and in the other from brachyceros and thoracic humped zebu. The paper is illustrated by perhaps the most complete set of photographs of African cattle breeds yet published.

Stomatopoda of the Bingham Oceanographic Collection

G. ROBERT LUNZ has reported on the Stomatopoda from various localities collected by the *Pawnee* and from coastal trawlings by members of the Bingham Oceanographic Laboratory (*Bull.* Bingham Oceanographic Collection. Peabody Museum of Natural History, Yale University, 5, Art. 5; Jan. 1937). There is also included valuable material collected on the west coast of Florida by Miss M. Storey of Stanford University and a few specimens from Tahiti obtained by Mr. Henry Sears. 157 specimens are recorded, referable to five genera and thirteen species. A new variety is described from Tahiti of *Gonodactylus chiragra*, a species well known throughout the tropical portions of the Pacific and Indian Oceans but not before recorded from Tahiti, also a new variety of *Chloridella rugosa*, and there is one new species, *Chloridella edentata*, described from a single specimen, its nearest relative being *C. mantoidea*.

Cytology of *Gagea spathacea*

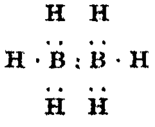
Gagea spathacea is a member of the Liliaceæ occurring from southern Sweden through Denmark to Holland and Belgium. It apparently produces no seeds, its pollen is sterile and it reproduces vegetatively by numerous small bulbs. Dr. M. Westergård (*C. R. Lab. Carlsberg, Série Physiologique*, 21, No. 18), who has investigated its cytology, finds that while *G. lutea*, *G. minima* and *G. pratensis* undergo their pollen meiosis in Denmark in January, in *G. spathacea* this is delayed until April. *G. minima*, the most nearly related species, has $n = 12$, while in *G. spathacea* $2n =$ *circa* 102 and the chromosomes fail to pair in meiosis, with resulting micro-nuclei. This species is probably a hybrid; but it is not clear how its more than octoploid number of chromosomes has been reached. Its vegetative spread to Sweden must have occurred when the Baltic sea was a lake, unless it arose independently through crossing in the northern area. The embryo-sacs of *G. minima* and *G. lutea* ($n = 36$) were examined, and stages were found indicating that the sac is of the type now known in *Lilium*, *Fritillaria* and *Tulipa*, that is, the four megaspore nuclei function, three passing to the chalazal end of the sac and one to the micropylar end. Here they all divide again, the chalazal spindles fusing so that two triploid nuclei result. One of the latter degenerates while the other divides. The mature sac thus contains an egg apparatus composed of three haploid nuclei and two triploid antipodal cells. In double fertilization a pentaploid endosperm arises from the fusion of a haploid and a triploid nucleus with the male nucleus.

Magnetostriction

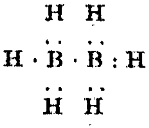
THE June issue of the *Science Reports* of the University of Sendai, Japan, contains two reports of the Research Institute of Iron, Steel and other Metals by Dr. Y. Masiyama, which deal with his recent work on magnetostriction of iron, nickel, cobalt, single crystals of iron and binary alloys of the three metals. The specimens were ovoids placed in the centre of a magnetizing coil, the field of which could be varied from 0 to 400 gauss. The changes of length of each ovoid were determined by fixing it between two quartz tubes coaxial with it, one of which projected out of the coil and ended in a small brass block. To compensate for temperature changes of length of the ovoid, a brass bar of suitable length was placed within the coil parallel to the axis of the ovoid and between two similar quartz tubes. Between the brass blocks a thin spindle carrying a mirror was placed in such a way that differential changes of length of ovoid and brass rod produced a rolling of the spindle and rotation of the mirror. The changes of length observed are generally less than 30 millionths at the maximum field, and are shown by curves in terms of the field and of the magnetization. They are independent of the sign of the field and at low fields are different for increasing and decreasing fields. For cobalt and nickel and alloys of the two the length decreases; for iron and alloys containing iron the length decreases at first, then increases as the field is increased. Each material tested showed hysteresis in its magnetostriction, and the effect will have an important bearing on the theory of magnetization.

Structure of Diborane

AN outstanding difficulty for the valency theory is the molecule B_2H_6 and the non-existence of the molecule BH_3, since boron is a tervalent element in numerous other compounds. Some light is thrown on the problem by determinations of the inter-atomic distances by S. H. Bauer (*J. Amer. Chem. Soc.*, **59**, 1096; 1937), by means of the electron diffraction method. The values for the B—B (1·86 A.) and B—H (1·27 A.) distances are considerably larger than the single-bond separations expected from other diatomic hydrides. This is interpreted as meaning that the bonds in the molecule have to some extent a character weaker than single bonds. This would be expected for the B—H bonds on the basis of structure I:

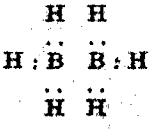
I 

$$\mathrm{H}\cdot\underset{\underset{\mathrm{H}}{\cdot\cdot}}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{B}}}}:\underset{\underset{\mathrm{H}}{\cdot\cdot}}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{B}}}}\cdot\mathrm{H}$$

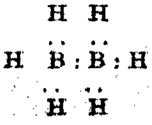
II 

$$\mathrm{H}\cdot\underset{\underset{\mathrm{H}}{\cdot\cdot}}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{B}}}}\cdot\underset{\underset{\mathrm{H}}{\cdot\cdot}}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{B}}}}:\mathrm{H}$$

which gives each B—H two thirds single-bond and one third one-electron-bond character. A slight extension considering resonance to structures such as II would further account for the increased B—B distance. The distances are also compatible with a structure representing resonance among the seven arrangemens:



$$\mathrm{H}:\underset{\underset{\mathrm{H}}{\cdot\cdot}}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{B}}}}\quad\underset{\underset{\mathrm{H}}{\cdot\cdot}}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{B}}}}:\mathrm{H}$$



$$\mathrm{H}\quad\underset{\underset{\mathrm{H}}{\cdot\cdot}}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{B}}}}:\underset{\underset{\mathrm{H}}{\cdot\cdot}}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{B}}}}:\mathrm{H}$$

etc.

giving each bond 6/7 single-bond and 1/7 no-bond character. Theoretical arguments support the view that the molecule resonates among all the above structures, the B—B and B—H bonds having single-bond, one-electron-bond and no-bond characters. Shortening of the B—B distance below the single-bond value is not observed; this is regarded as eliminating all structures such as Wiberg's, which attribute some double-bond character to the B—B link. The stability of B_2H_6 relative to BH_3 is explained as due to the resonance energy made available by the full use of the four orbitals of boron.

High Intensity Light Sources

AN article by Dr. J. A. V. Fairbrother in the *Electrical Review* of August 6 discusses the light source required to project a beam within a fairly small angle. Practical considerations permit only a small source, as otherwise a large paraboloidal reflector would be required. The lower limit to the size of the light source is fixed by its brightness (intrinsic brilliancy) and the quantity of light obtainable from it. The intrinsic brilliancy is measured by the candle power divided by the projected area of the source on a plane perpendicular to the direction of view. It is convenient to measure it in candles per square millimetre. For bodies which emit full radiation the intrinsic brilliancy increases rapidly as the temperature approaches the melting point. As carbon and tungsten have the highest melting points, the carbon arc and the hot tungsten filament are the two high-intensity light sources usually employed for projection purposes. But owing to the fact that much of the spectral emission from a hot surface is not in the visible region, it is an inefficient converter of heat into light. One of the earliest light sources was the Welsbach mantle, which made use of the selected radiation from cerium and thorium. At the present time the most promising of all is the selected light emission from gases and vapours the molecules of which are excited by the passage of an electric current. By exciting mercury vapour in a quartz envelope at a high pressure, a light source is attained which has a higher efficiency and greater intrinsic brilliancy than over-run tungsten. The author has obtained with a carbon arc a maximum brilliancy of 330 candles per sq. mm. which is about eighteen times the average intrinsic brilliancy of the 5-kw. tungsten filament spot lamp. Mercury vapour quartz lamps are now being made the length of the arc of which is only about 10 mm. and which when the temperature is kept low by cooling water in contact with the outer wall of the envelope can take an input of 700 watts. This lamp approaches the carbon arc in intrinsic brilliance and is more than twice as efficient.

Sunspot Photography with a Small Visual Refractor

THIS is the title of a paper by Mr. Cecil Maby (*J. Brit. Astro. Assoc.*, **47**, 9, July 1937), in which the author gives the results of his experiments with different filters and photographic plates. He made use of his telescope and its Huygenian eyepiece as projection lenses, and those who are interested in the photography of sunspots will find much useful information in this paper on the employment of visual refractors for this purpose. The paper should be studied by amateur astronomers, who will find a full description of the equipment, which is both efficient and inexpensive.

ERRATUM. The paper referred to under the heading "Petrofabric Study of Moine Schists" in NATURE of September 4 (p. 429) was by Dr. F. C. Phillips, Department of Mineralogy and Petrology, Cambridge, and not by F. C. Cole as stated.

Engineering and Marine Exhibition at Olympia

AT this Exhibition, which will remain open until October 2, there is so much of scientific interest that it is possible only to select a few representative items as indicative of the extent to which the results of research are being utilized with the aid of mechanical ingenuity. One gets, for example, a definite impression of a universal effort being made to deal with the problem of noise both by improvements in design and workmanship and by the adoption of new types. At one stand a noiseless sliding door is exhibited, and of silently operating machinery a notable example is the Mirrlees-Imo pump for oils and other liquids. This has only three moving parts—a central screw which is the actual pumping unit, and two side screws which act as seals and are rotated merely by their engagement with the central screw. In high-speed Diesel engines vibration is destructive of the exhaust pyrometers which, by the close relationship between exhaust temperature and horse power, are necessary to ensure that an even and efficient balance is maintained between the several cylinders. Messrs. Negretti and Zambra are exhibiting pyrometers in which a few inches of the tube immediately below the instrument have been replaced by a helical spring, and instruments so constructed are to be seen mounted on a vibrating table yet relatively unaffected.

The hygienic importance of the reduction of dust lends interest to means for its measurement, and the Tyndallometer shown by E. Leitz (London) provides a new and rapid means of its measurement. It consists of a dust chamber, a photometer head, an observation telescope and the necessary means of illumination. In the field of view is a beam of the scattered light and a comparison beam and, when these are equalized, the scale reading and the calibration curve give an instantaneous value for the dust content. On the same stand is shown a simple profile projector for the metal industry with several other optical aids. Messrs. Kelvin, Bottomley and Baird, Ltd., have on view the colour vision lantern developed by Dr. L. C. Martin in collaboration with the Medical Research Council, and also the K.B.B. Cabinet for ultra-violet fluorescence. The latter can be seen in operation with a very representative group of samples which illustrate its value in scientific testing and research, and also in industrial, medical, police and other investigations. In Messrs. Avery's recent design of Brinell and diamond impression testing machine the arrangement is such as to enable results to be obtained very rapidly, and in this respect alone this exhibit marks an advance on the usual design.

Under modern conditions, metals are frequently required to conform to very severe specifications, and Barronia Metals, Ltd., are exhibiting examples of many such problems which they have solved. One of these was the preparation of a non-ferrous alloy with a coefficient of expansion greater than steel for use with a hydrocarbon gas containing sulphur at a pressure of 200 lb. per sq. inch and a temperature of 1150° F. Other instances of new developments in manufacture of materials are the glass cloth now being made by Chance Bros. and Co., Ltd., to replace asbestos cloth in low-temperature services and likely also to develop in decorative and other directions, and the method of electric forging which has been brought to a fine art by Messrs. Omes, Ltd. The samples of forgings exhibited indicate the wide application of the process and the high quality both of material and of surface which is obtainable. In conjunction with H. A. Brassert and Co., Ltd., Messrs. Imperial Chemical Industries Ltd. illustrate the Brassert process for acid burdening the blast furnace. By regulating the flux so as to form slag of the lowest possible melting point and viscosity, iron production is increased while less coke is used and low-grade ores can be dealt with. As a result also of the sodium carbonate treatment there is a reduction of sulphur and, due to oxidation, of silicon content. The Macrome treatment of tool steel by an electric process, applied after the usual heat treatments have been given, is claimed by Messrs. Macrome Ltd. to increase the working life of tools by 50–300 per cent according to the steel treated and the work performed. An electric process exhibited by the O.C.P. Company is that for conditioning water and preventing scale in boilers. The water is made to pass through tubes each containing an electrode, and this process effects a physical change in the mineral salts which, on being heated, appear as crystals and do not build up scale. The elimination of chemical treatment is an obvious advantage of the method.

The Marconi Company has arranged a series of historical exhibits illustrating the development of wireless apparatus. Another exhibit of this firm shows how one type of echometer can indicate to a trawler the depth of the sea-bed and also that at which a shoal of fish may be passing. The Accurate Recording Instrument Co. has working models of a liquidmeter which will very soon be manufactured. This, although very sensitive and carefully compensated, is of a robust construction and is not likely to get out of order. It operates by means of two pairs of opposed hydraulic bellows so that the displacements made in the tank are exactly reproduced at the dial. Among other recording instruments, Messrs. Radiovisor show the counting unit such as is used in the Mersey Tunnel to give a record of vehicles entering and also in factories for counting sacks, tins, etc., by the interception of a beam of light.

Of the many Diesel engines on view, that of the Brush Electrical Engineering Co. Ltd. will be of considerable interest to engineers. It is a horizontal type and has four cylinders arranged in pairs on opposite sides of the crankshaft. An independent test by Mr. W. A. Tookey showed the fuel consumption to be 0·357 lb. per B.H.P. hour when developing 250 B.H.P. at a speed of 250 r.p.m.

The exhibit, however, which takes the highest place in scientific importance and which at the same time appeals to all who are mechanically minded is that of the Department of Scientific and Industrial Research and associated bodies. It illustrates researches carried out in engineering and metallurgy, showing how the tests are made on models of ships' hulls and propellers, on coal, on the transport and storage of food and on fire resistance of structures. By the use of short films the visitor sees more than the mere instruments and materials of the test; he is enabled to follow the course and operations of the investigation.

Origin of the Red Rocks

THE subject for discussion in Section C (Geology) at the British Association on the morning of September 2 was the "Origin of the Red Beds of the Northern Midlands". Speakers, however, did not confine themselves to local conditions, and other parts of England were also considered.

In opening, Dr. R. L. Sherlock remarked that the region discussed forms an indefinite area but may be supposed to include the Cheshire Basin, the synclines between the fanning-out ridges of the Pennine Range and the easterly dipping beds of Nottinghamshire.

It is agreed that the British Permo-Trias is of Continental origin and that the climate became progressively drier from the beginning to the end of the period. This fact seems to be of almost worldwide application, for it is also true for the United States, South Africa and other countries.

Late in Carboniferous time, earth-movements on a great scale probably raised Great Britain into mountains, but rapid erosion of the soft Coal Measures soon reduced the elevation, and the detritus filled the hollows and formed red beds. This indicates oxidation of grey strata in a dry climate. There is a relation between colour and texture; the finer the grain the richer the red tint, owing no doubt to ease of oxidation. The green colour found at times appears to indicate wetter periods. Although there is no doubt that secondary changes of colour have occurred, it is highly probable that both red and green strata are primary. Evidence for the primary origin of red beds is that the colour is constant in depth. It is noteworthy that green marls occur at the top of the Keuper, just before the Rhætic Sea burst in, when base-levelling of the land had presumably allowed wet oceanic winds to bring in a damper climate.

Although the saline deposits were no doubt deposited in drying up inland seas and lakes, the source of supply offers difficulties. Ordinary sea water, if evaporated, would deposit only 0·7 ft. of gypsum or anhydrite for each 1,000 ft. of depth, yet beds 10 ft. or more in thickness were deposited from shallow seas. Evidently there was local concentration.

Gypsum often shows swirl-like structures, and so does rock-salt. In Cheshire, stratification and cross-bedding are also present in the salt, indicating a possible explanation of the thickness of saline deposits. If evaporation caused supersaturation of the water, the salt would be deposited very rapidly and the granular precipitate might be concentrated by currents. It sometimes happens that, if two bore-records are compared, one containing thick salt and the other none, the records agree roughly if the salt is ignored, suggesting that the time of formation of the salt was negligible.

While the rest of our salt deposits were formed in desert lakes, the Middlesbrough deposits represent a dried-up sea.

Mr. F. W. Shotton communicated the results obtained by the Lapworth Club of the University of Birmingham in an investigation, lasting several years, of the outcrops of Lower Bunter in Worcestershire and East Shropshire between Oakengates, Bewdley and Stourbridge. Every accessible outcrop was examined and careful measurements made of dip and false bedding; more than a thousand readings being taken and examined statistically. In addition, numerous rock specimens were collected and examined for variation in the size of the sand-grains. Conclusions arrived at were that, throughout the area, the Lower Bunter is false-bedded and that it was deposited on land by easterly winds coming from the Mercian Highlands. The sand is remarkably well-graded and free from clay or silt-bands, and 90 per cent lies between the ranges of 0·50 mm. and 0·10 mm.

Mr. A. N. Thomas then described the Trias of north-west Somerset between Porlock and Williton. The Triassic subsurface is highly irregular and the earliest deposits fill in isolated depressions, the later ones being increasingly widespread so that the areas tend to coalesce.

Dr. S. E. Hollingworth gave an account of some results of recent borings in the Vale of Eden. These borings have proved the presence of three horizons of anhydrite in the 'Permian' Hilton Plant Beds at Kirkby Thore, although only two horizons are known elsewhere in the area. As these chemical precipitates indicate periods of desiccation, they are probably due to regional climatic changes, and it is reasonable to suppose that sequences of such deposits in adjacent areas may be correlated. This does not necessarily mean that two areas of deposition were united. Dr. Hollingworth correlates the lowest anhydrite bed (base of Hilton Plant Beds) with the lower salt (and anhydrite) at the base of the 'Permian Middle Marl' of the region east of the Pennines. The two higher horizons of the Vale of Eden he correlates with the upper salt and anhydrite and the upper anhydrite respectively of Yorkshire. Correlations between Cumberland and Furness indicate the probability of a lateral passage from 'Permian' Hilton Plant Beds to 'Triassic' St. Bees Shales. Dr. Hollingworth's conclusion is in accordance with the evidence from the east of the Pennines of a lateral passage of 'Permian' into 'Trias' brought forward in 1911 by Dr. R. L. Sherlock.

No time was left for discussion, but inquiries were made as to where the formation of red beds in Continental areas is at present in progress. This difficulty is analogous to that felt by students of coal formation—the origin of which by swamp-growth is generally agreed upon, although the exact conditions for it do not seem to exist anywhere at the present day. Nevertheless, in various parts of the world certain kinds of Triassic-like rocks are being formed, for example, in Turkestan, although nowhere can all the types be found now forming.

As was pointed out by Dr. Rudolf Richter on another occasion, when describing conditions of sedimentation off the German coast, we must not carry uniformitarianism too far; special conditions existing at certain periods have never been repeated.

R. L. S.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Wednesday, September 29

Society for the Study of Alchemy and Early Chemistry, at 8—(at University College, Gower Street, W.C.1).—Dr. D. McKie: "Some Early Work on Combustion, Respiration and Calcination".*

National Smoke Abatement Society, October 1–2.—Ninth Annual Conference to be held at Leeds. Dr. H. A. Des Voeux: President.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Civil Engineering Assistants in the Headquarters and Divisional Road Engineer's Offices of the Road Department of the Ministry of Transport—Establishment Officer of the Ministry, Metropole Buildings, Northumberland Avenue, W.C.2 (September 27).

Assistant in the Department of Civil Engineering, Queen's University, Belfast—Prof. Hummel (September 28).

Engineer in the Directorate of Factories, War Department—Chief Superintendent, Ordnance Factories, Royal Arsenal, Woolwich (September 28).

Assistant Master for Electrical Engineering in the Llanelly Mining and Technical Institute—Clerk of the Education Committee, County Education Offices, 24 King Street, Carmarthen (September 28).

A Designer (Ref. No. 542 B) and **an Assistant** (Grade II) (Ref. No. 550 B) for work in the Stress Section of the drawing office, and a **Technical Officer** (Ref. No. 574 B) and **Assistants** (Grade III) (Ref. No. 589/590 B) for work on electrical equipment of aircraft, at the Royal Aircraft Establishment, South Farnborough, Hants—Chief Superintendent (October 1).

Assistant Lecturer in the Chemistry Department at Robert Gordon's Technical College, Aberdeen—Secretary and Registrar (October 2).

Junior Assistant in the Science Museum Library—Director (October 4).

Lecturer in Physics in the South-East Essex Technical College, Dagenham—Clerk to the Governors (October 4).

Officer-in-Charge of Poultry Research Section, Imperial Veterinary Research Institute, Iznagar, United Provinces, India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 8).

Chief Lecturer in Electrical Engineering at the West Ham Municipal College, Stratford, E.15—Principal (October 9).

Two Assistant Keepers (Second Class) on the Higher Technical Staff of the Science Museum—Director, envelopes marked "Assistant Keeper" (October 11).

Second Assistant Petroleum Technologist for the Government of Trinidad and Tobago—Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (October 15).

Wm. Hudson Professor of Economics in Natal University College, Pietermaritzburg and Durban, South Africa—Registrar, Natal University College, Pietermaritzburg, Natal (November 9).

Assistant in Zoology in the University of Glasgow—Secretary, University Court.

Master for Mechanical Engineering at the Technical Institute, Ashford—Principal.

Railway Engineer (temporary) for H.M. Office of Works—Chief Architect, Room 65A/3rd, H.M. Office of Works, Storey's Gate, S.W.1.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records, No. 21: The Growth and Structure of Wood. By B. J. Rendle. Pp. iii+24+1 plate. (London: H.M. Stationery Office.) 6*d*. net. [39

Ordnance Survey. The Magneto-Theodolite. Pp. 12+4 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [39

Mines Department. Fifteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1936. Pp. 130+14 plates. (London: H.M. Stationery Office.) 2*s*. net. [39

Board of Trade. Survey of Industrial Development, 1936: Particulars of Factories opened, extended and closed in 1936; with some figures for 1935. Pp. iv+38. (London: H.M. Stationery Office.) 9*d*. net. [39

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1937–38. Pp. 414. (Manchester: College of Technology.) [69

City of Birmingham. Annual Report of the Mental Hospitals Committee, April 1st, 1936, to March 31st, 1937. Pp. 30. (Birmingham.) [69

Record of the Royal Institution of Great Britain, 1937. Pp. 180. (London: Royal Institution.) 5*s*. [69

Proceedings of the Physical Society. Vol. 49, Extra Part, No. 274: Report of Conference on the Conduction of Electricity in Solids, held at Bristol, July 1937. Pp. vii+154. (London: Physical Society.) 7*s*. net. [79

Department of Scientific and Industrial Research. Forest Products Research Records, No. 20 (Timber Series, No. 6): The Properties of British Honduras Pitch Pine (Slash Pine)—*Pinus caribaea* Mor. Pp. ii+9+2 plates. (London: H.M. Stationery Office.) 6*d*. net. [79

Birkbeck College (University of London). The Calendar for the Year 1937–38. Pp. 272. (London: Birkbeck College.) [89

Battersea Polytechnic. Technical College for Day Students: Calendar for the Session 1937–1938. Pp. 47. 3*d*. Domestic Science Department and Training College: Calendar for the Session 1937–1938. Pp. 34. 3*d*. Department of Hygiene and Public Health: Calendar for the Session 1937–1938. Pp. 20. 3*d*. Evening and Afternoon Courses and Classes: Calendar for the Session 1937–1938. Pp. 36. Free. (London: Battersea Polytechnic.) [89

Other Countries

Canada: Department of Mines and Resources. The Canadian Mineral Industry in 1936. Reviews by the Staff of the Bureau of Mines. (No. 786.) Pp. iii+78. 25 cents. Analyses of Coals and other Solid Fuels, 1934 to 1936. Appendices. 1: Analyses of Coals and Peats, 1918 to 1925, hitherto Unpublished; 2: Analyses of Ash from Coals, Cokes, Peat and Woods. Compiled by J. H. H. Nicolls and C. B. Mohr. (No. 779.) Pp. iii+139. 25 cents. (Ottawa: King's Printer.) [69

Royal Observatory, Hong Kong. Magnetic Results, 1936. Prepared under the direction of C. W. Jeffries. Pp. 49. (Hong Kong: Royal Observatory.) 1 dollar. [69

Det Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser 13, 7: Rhythmic Diurnal Variations in the Œstrous Phenomena of the Rat and their Susceptibility to Light and Dark. By Axel M. Hemmingsen and Niels B. Krarup. Pp. 61+4 plates. 3.00 kr. Biologiske Meddelelser 13, 8: The Production of Mating Instincts in the Rat with Chemically Well-defined Œstrogenic Compounds. By Axel M. Hemmingsen and Niels B. Krarup. Pp. 10. 0.50 kr. (Copenhagen: Levin and Munksgaard.) [69

Department of Agriculture, Straits Settlements and Federated Malay States. Insects, Fungi and Bacteria associated with Copra in Malaya. 1: Insects associated with Copra in Malaya; 2: Deterioration of Copra caused by Bacteria and Moulds. By G. H. Corbett, Mohamed Yusope, Abu Hassan and F. S. Ward. Pp. iii+108+11 plates. (Kuala Lumpur: Department of Agriculture.) 50 cents. [69

Memoirs of the Geological Survey of India. Palaeontologia Indica. New Series, Vol. 24, Memoir No. 1: The Eocene Beds of the Punjab Salt Range. By Lieut.-Col. L. M. Davies and E. S. Pinfold. Pp. iii+79+7 plates. (Calcutta: Geological Survey of India.) 6.2 rupees; 10*s*. [69

The Genus Youngia. By Ernest B. Babcock and G. Ledyard Stebbins, Jr. (Publication 484.) Pp. iii+106+5 plates. (Washington, D.C.: Carnegie Institution of Washington.) [79

Southern Rhodesia. Meteorological Report for the Year ended 30th June 1936. Pp. 45. (Salisbury: Government Stationery Office.) [79

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University. Vol. 3, Art. 7: Concluding Report on Fishes, with Species Index for Articles 1–7 (Fishes of the Third Oceanographic Expedition of the *Pawnee*). By Albert Eide Parr. Pp. 79. Vol. 6, Art. 1: A Contribution to the Chemistry of the Caribbean and Cayman Seas. By Norris W. Rakestraw and Homer P. Smith. Pp. 41. Vol. 6, Art. 2: On the Longitudinal Variations in the Dynamic Elevation of the Surface of the Caribbean Current. By Albert Eide Parr. Pp. 20. (New Haven, Conn.: Peabody Museum of Natural History.) [79

South Australia: Department of Mines. Mining Review for the Half-Year ended 31st December 1936. (No. 65.) Pp. 105+6 plates. (Adelaide: Government Printer.) [89

South Australia: Department of Mines: Geological Survey of South Australia. Bulletin No. 16: Geology of the Northern Part, Hundred of Macclesfield, with Special Reference to its Economic Aspects. By Ralph W. Segnit. Pp. 63+3 plates. (Adelaide: Government Printer.) [89

Catalogues, etc.

A Pamphlet on Cambridge CO_2 Apparatus for the Steam Raiser (Folder No. 60.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Priced Catalogue of B.D.H. Laboratory Chemicals. Pp. iv+204. Plant Hormones: Substances promoting and controlling Cell Growth and Root Formation in Plants. Pp. 4. (London: The British Drug Houses, Ltd.)

Catalogue of Books on Natural History: including Anthropology, Botany, Entomology, Evolution, Zoology, Ornithology, etc. Pp. 44. (London: W. and G. Foyle, Ltd.)

Natural History. List No. 1. Pp. 6. (Den Haag: Antiquariaat W. Junk.)

Conti-Glo Luminescent Products. Pp. 4. (Cleveland, Ohio: Continental Lithograph Corporation.)

A Catalogue of Books and Periodicals on all Classes of Zoology. (No. 540.) Pp. 120. (London: Bernard Quaritch, Ltd.)

Photomicrography with the Vickers Projection Microscope. (Publication No. 872.) Pp. 64. (York: Cooke, Troughton and Simms, Ltd.)

Societies and Academies

Paris

Academy of Sciences, July 19 (*C.R.*, **205**, 185–264).

Marcel Delépine and **Charles Hanegraaff**: The catalytic hydrogenation of cinnamic aldehyde and of citronellal. Study of the order of attack of the aldehyde group and the double bond, using Raney nickel with and without platinizing.

Richard Fosse and **Roger de Laramberguе**: The mechanism of the synthesis of cyanamide in the oxidation of glucose in the presence of ammonia.

Henri Colin and **Henri Belval**: Chemical affinities and classification in the Hordeæ.

Pierre Lejay: New determinations of the acceleration of gravity in Europe and in the Levant.

Jacques de Lapparent: Ancient phenomena of rubefaction in the central Sahara.

Lucien Daniel: New observations on grafting.

Folke Odqvist: Equations of compatibility for any system of orthogonal triple co-ordinates.

Lucien Godeaux: Algebraic varieties of genus unity containing cyclic involutions.

M. Eidelheit: Systems of linear equations with an infinity of unknowns.

J. Kuntzmann: Homomorphy between multiform systems.

Robert Wagner: Multivalent functions in space of matrices.

Florin Vasilesco: An application of normal families of distributions of mass.

Nicolas Cioranesco: The deformation of elastic plates in the case of analytical data.

Jean Galibourg and **Pierre Laurent**: Subpermanent deformations (reactivity phenomena).

Jean Malfitano: The constitution of the photon considered as a dipole.

Mme. Zina Soubarew-Châtelain: The variations of conductivity undergone by dilute solutions of molybdic acid in the course of their neutralization. The experiments described support the theory of the existence of the acid $H_2Mo_2O_7$.

O. Dony-Hénault and **A. de Jaer**: Study of electrolytic vessels with mercury cathode.

Maurice Fallot: The magnetic properties of the alloys of iron with ruthenium and osmium.

Roger Servant: The double refraction of quartz in the extreme ultra-violet and the Schumann region.

Lucien Maillet: The emission of X-rays by vacuum tubes of very small dimensions, submitted to a high-frequency current. The tubes described were 2–6 cm. long and 3–5 mm. in diameter, fitted with a single wire anode. Some applications in the field of radiotherapeutics are indicated.

Mordechai Bobtelsky and **Mlle. Mélanie Rappoport**: The decomposition of hydrogen peroxide in the presence of a cobalticitric complex compound as catalyst.

Pierre Trunel: The electric moments of some fatty dinitriles.

Raymond Quelet and **Jean Allard**: The chlormethylation of anisic aldehyde. Passage to 1-methoxy-2-methylol-4-methylalbenzene.

Lucien Dautrebande, **Pierre Angenot** and **Edmond Dumoulin**: Study of antiærosol esparto grass filters. The influence of the hygrometric state on the penetration of antiærosol filters. The influence of the time of passage of the moist atmosphere.

R. Russo: The Kimmeridgian age of the terminal layers of the western Beni Snassen (Morocco).

Charles Chabrolin: The germination of the seeds of *Orobanche speciosa*.

Robert Echevin and **Roger Ulrich**: The nature of the intravacuolar inclusions in the fruit of the ivy (*Hedera Helix*).

Pierre Drach: Generalities on the development of the crystalline textures in the tegumentary skeleton of the brachyurous Decapods.

Jean Régnier and **André Quevauviller**: The influence of the nature of the acid on the action exercised on the motor nerve by different salts of novocaine and morphine: different qualitative behaviour according to the concentrations.

Paul Fortin: Very clear entoptic vision of the retina in the orange red.

Marcel Avel: Experimental analysis of the determination of the dorso-ventral axis in the regeneration of the head in worms.

Etienne Wolff: Egg laying anomaly in an intersexed fowl, after the action of androsterone, on the Müller ducts of the embryo.

Augustin Boutaric and **Mme. Madeleine Roy**: Spectrophotometric researches on aqueous solutions of bile.

Jean Loiseleur and **Mlle. Renée Colliard**: The adsorption of polypeptides by the proteins of the blood serum.

Charles Champy, **Maurice Heitz-Boyer** and **Roger Coujard**: The mechanism of the hormonosexual actions on the dysuria of prostatics.

Moscow

Academy of Sciences (*C.R.*, **15**, No. 5, 1937).

S. Bergmann: A theory of functions satisfying a linear partial differential equation (1).

V. S. Ignatovskij: The Laplace transformation (8).

L. Lusternik: A generalization of the equation of the Sturm-Liouville type.

A. Bobrov: The relative stability of sums of positive quantities.

V. Fock: The Bose amplitudes in the neutrino theory of light.

A. Toporec: The mechanism of the formation of atomic and colloidal centres of silver in alkali phosphorus halide.

L. I. Belajev: The problem of the electrophoresis of lamellæ at the interface of liquid phases.

P. J. Schmidt and **G. P. Platonov**: Anabiosis and fish transport without water. Experiments are described showing the possibility of preserving chilled fishes alive for more than twenty-four hours, while smaller fishes can be revived after chilling for ten days.

J. N. Golubinskij: A tetraploid form of *Ocimum canum* Sinis produced experimentally.

D. J. Vakulin: Reaction of reversibility in *Perilla ocymoides* L. under natural conditions.

T. T. Demidenko: Iron in the nutrition of higher plants.

V. L. Vagin: The position of the Ascothoracida ord. nov. (Cirripedia Ascothoracica Gruvel 1905) in the system of Entomostraca.

P. J. Schmidt: The Pacific genera *Eurymen* Gilbert and Burke and *Gilbertidia* C. Berg (Pisces, Cottidæ).

G. V. Lopashov: (i) The formation of organs in organisms deprived of the nervous system. (ii) The specificity of inductive influences.

University Events

GLASGOW.—Prof. George Barger, professor of chemistry in relation to medicine in the University of Edinburgh, has been appointed Regius professor of chemistry in the University in succession to Prof. George Henderson, who has resigned.

Dr. Noah Morris, lecturer in biochemistry, has been appointed professor of materia medica and therapeutics.

Science News a Century Ago

The Iron Ship *Sirius*

THE first iron ship to be classed by Lloyd's Register of Shipping was the steamer *Sirius*, the records of Lloyd's Register stating she was built under the inspection of the Society's London surveyors, and intended for service on the River Rhone, her port of registry being Marseilles. The *Sirius* was built by William (afterwards Sir William) Fairbairn at his yard at Millwall, which afterwards formed a part of the yard at which the *Great Eastern* was constructed. According to the *Railway Magazine*, she was launched on September 26, 1837, and she was the longest vessel so far built of iron. She measured about 164 ft. in the keel and 176 ft. on deck. Her beam was 17 feet. She was intended to be worked by two high-pressure engines of 35 horse-power each having a 24-in. cylinder with a stroke of 3½ ft. She was to have three boilers with copper tubes. "The iron planks of which she is made", said the *Railway Magazine*, "are about 7 ft. long, 14 in. wide and a quarter of an inch thick, and her ribs are of double angle iron with diagonal stays. Her mould is handsome, but rather narrow; and when she has her machinery and water, it is calculated she will not draw above two feet of water. She is besides, divided into four compartments by three iron water-tight bulkheads; so that if a fracture should happen in any one part she will still float safely."

Fossil Discoveries in France

IN its column of Miscellanea, the *Athenæum* of September 30, 1837, under the title "More Fossils", said: "M. Azéma has found some fossil bones of mastodons and the rhinoceros, reptiles, and some well-preserved fruits in the parish of Sauveterre, near the district explored by M. Lartet, whose discoveries we announced some time back. We should like to ascertain whether the skeleton of the new and remarkable rhinoceros brought from behind the Cape by the expedition under Dr. Andrew Smith, presents more affinity to the recent or to the fossil species. It seems that the new fact concerning fossil quadrumana has been succeeded by a similar discovery in the Himmalaya mountains, but which is not so curious as the circumstance of finding these animals in Europe; and what is still more extraordinary, the comparative anatomists have determined the European species to be similar to those Gibbons which inhabit the remotest parts of Asia. M. Lartet's discoveries have given rise to much discussion in the French Academy of Sciences. . . ."

Reforms in the Hospitals

A CORRESPONDENT signing himself "Spectator" in a letter to the *Lancet* of September 30, 1837, mentions the following improvements which had taken place at the London hospitals during the previous ten years:

"1. The introduction of clinical lectures, a department of instruction which was before shamefully neglected in this country, and is even yet but imperfectly taught. 2. The publishing of hospital reports, a measure forced upon the medical officers by *The Lancet*. 3. The annual distribution of prizes to the students (which did not become general until after 1826). 4. The withholding of certificates unless a *few* lectures have been attended; for I remember the time when it was not an uncommon occurrence for a student to boast that he had received a certificate without having attended a single lecture. Lastly, I may mention the posting of post-mortem examinations; the absence of hole and corner operations; the opening of the libraries and museums; the establishment of clerical clerkships, the greater punctuality in the visits of the medical officers (although, I confess, there is much yet to reform in this respect) and the frequency of periodical examinations by some of the teachers may also be added to the list of benefits on the part of the students which have reluctantly been obtained from the 'Dubs and Pures'."

Medal Striking

THE *Gentleman's Magazine* of September 1837 contains the following announcement: "M. Pistrucci, chief medallist in the Royal Mint, has discovered a method by which he can stamp a matrix or a punch from a die which has never been touched by an engraver, and yet still make the medal identically the same with the original model in wax; an operation by which the beauty and perfection of the master's design are at once transferred to any metal, whether gold, silver or copper, by striking it according to the usual process. The model being made in any substance, wax, clay or wood or other fit material, a mould of it is taken in plaster, from which mould when dried and oiled to harden it, an impression is taken in sand, or other similar substance which may be preferred, and from this again a cast is obtained in iron as thin as possible, that the work may come out sharply, and the iron attain the hardness almost of a steel die hardened."

Spirit Drinking in India

AN editorial in the *Indian Journal of Medical and Physical Science* of October 1, 1837, contains the following warning to the Government: "The lives of European soldiers in this country are unhappily passed in a state of imprisonment in their barracks from 10 o'clock in the morning to 4 o'clock in the evening. There is nothing of that change of scene and agreeable occupation of time as experienced by British soldiers in their own congenial and delightful country. Their indolence and want of amusement tend to a despondency of mind, and to depression of the whole animal functions, to arouse which spirits are had recourse to, and which is in fact looked upon as a necessary and luxurious pastime, sanctioned as a ration, and approved of as a custom. Canteens are rooms appointed by military rule as a place of refuge to gratify the appetite, by adding the indulgence in liquor to social conviviality. But is the Government of the country aware that all this breaks up the physical energies both bodily and mental of their brave troops?"

The Teaching of Mathematics

THE mathematical subsection (A*) of the British Association departed this year from its usual policy of presenting papers on specialized branches of research, and its sessions at Nottingham were devoted chiefly to two discussions on the teaching of mathematics. On Saturday, September 4, Prof. E. H. Neville opened a discussion on the unification of algebra in schools. Mr. T. A. A. Broadbent condemned the older school text-books as a collection of water-tight compartments, and pointed out the need for the course to be systematized and unified. Mr. G. L. Parsons contrasted the older method of putting all the emphasis on technique with the newer methods of bringing out the ideas of the subject. He favoured the approach by means of the formula or the equation rather than by tedious drill in elementary algebraic processes. Mr. M. H. A. Newman gave the university point of view, particularly as regards the importance of linear transformations and matrices. Mr. W. J. Langford pointed out that changes in the school course could not be made unless such examinations as that for the School Certificate were modified correspondingly. He suggested that teachers should agree upon a policy, and then submit alternative syllabuses to the examination authorities.

The papers attracted a large audience, including many from other sections, and the lively discussion that ensued proved that the subject was felt to be of great interest and importance.

On Tuesday, September 7, Prof. H. T. H. Piaggio opened a discussion on the bearing of higher geometry on the school course. Prof. E. H. Neville protested against the policy of drill in the application of devices of which no rational explanation had been given. Mr. H. G. Green showed how to give this explanation in the case of the 'line at infinity', and Prof. W. H. McCrea in the case of the 'circular points at infinity'. Prof. H. S. Ruse pleaded for an extended treatment of differential geometry, including vector methods. A general discussion followed.

At the end of this discussion Mr. C. H. H. Franklin exhibited a most interesting collection of models representing four- and five-dimensional solids, by a principle analogous to that employed to represent three-dimensional solids by a sketch on two-dimensional paper.

The secretary of the subsection, Dr. Dorothy M. Wrinch, is to be congratulated on the success of the policy of replacing isolated papers by discussions on topics of wider interest. H. T. H. P.

Biological Standards[*]

THE proceedings of the meeting of the Permanent Commission on Biological Standardization held at Geneva in the autumn of 1935 have been published, together with the reports of the technical experts to whom a number of different questions dealing with biological standards had been referred.

Six standards were adopted or redefined by the Commission. The pituitary (posterior lobe) powder and the *Digitalis purpurea* leaf powder, at present in use as standards in Great Britain, stocks of which are held at the National Institute for Medical Research, Hampstead, were adopted as international standards, and the Institute was asked to distribute them on behalf of the Health Organisation. The original international standard pituitary powder was prepared by Prof. Voegtlin and was available for issue to authorities desirous of testing their national standards, but up to that time no laboratory had been entrusted by the Commission with its general distribution: the two preparations are of the same activity. The original international digitalis standard powder is nearly exhausted; but the stock of the British Standard is sufficient for international requirements for some time: its potency is, however, greater than that of the previous standard, so that one unit is represented by 0·08 gm. of the new standard, as compared with 0·1 gm. of the previous preparation. A crystalline sample of insulin was adopted as standard and defined as containing 22 units per mgm. The previous standard was amorphous and contained 8 units in one milligram. Two standards for substances for which standards had not been previously available were recommended for adoption: one for *B. histolyticus* antitoxin, and the other for diphtheria antitoxin for use in the flocculation test. The question of the standards for arsphenamine and its derivatives was left for further consideration by a small technical committee.

It was further agreed that work should be carried out on tetanus antitoxin, poliomyelitis convalescent serum, staphylococcus antitoxin and antityphoid serum. The recommendations adopted by the intergovernmental conference on biological standardization were considered and certain subjects recommended for further examination, including the standardization of anti-anthrax serum, anti-swine erysipelas serum, anti-venom serum and the preparation of a standard *Digitalis lanata* leaf powder.

The bulk of the report is devoted to the reports of the experts who have been examining proposed new standards, and gives the evidence on which the Commission has based certain of its recommendations; for the details of these experiments the original report must be consulted. The separate sections deal with insulin, histolyticus antitoxin, diphtheria antitoxin, tetanus antitoxin and antipoliomyelitis convalescent serum. The bulletin also includes reports of the Standards Departments of the National Institute for Medical Research, Hampstead, and the Statens Serum Institute, Copenhagen, and concludes with a useful description of a simple laboratory method for the desiccation of serum and other protein solutions.

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[*] *Quarterly Bulletin of the Health Organisation*. Special Number, November: Biological Standardisation (2). (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1936.) Pp. 571–745

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